TOTAL MAXIMUM DAILY LOAD (TMDL)

In

Ocklawaha River Basin

(Includes TMDLs for Coliforms, Metals and Nutrients)

Alachua, Marion, Putnam, and Lake Counties, Florida

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LIST OF ABBREVIATIONS

BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
SJRWMD	St. Johns River Water Management District
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WMP	Water Management Plan

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   County: Alachua, Marion, and Lake
   Major River Basin: Ocklawaha River Basin (HUC 03080102)

Impaired Waterbodies for TMDLs developed by EPA (1998 303(d) List):

WBID	Segment Name	Constituent(s)
2688	Hatchet Creek	Fecal Coliform
2698	Hogtown Creek	Total Coliform
2711	Sweetwater Branch	Total Coliform
2740C	Ocklawaha River above Lake Ocklawaha	Selenium, Silver
2740D	Ocklawaha River AB Daisy Creek	Fecal Coliform
2740F	Ocklawaha River/Sunnyhill	Total Coliform
2769	Daisy Creek	Fecal Coliform, Iron
2817A	Haines Creek Reach	Fecal and Total Coliforms
2838A	Lake Harris	Selenium
2717	Kanapaha Lake	Nutrients
2831B	Lake Dora	Silver

Impaired waterbodies for TMDLs developed by FDEP are in Appendix D-H

WBID	Segment Name	Constituent(s)
2740D	Ocklawaha River above Daisy Creek	Total Coliform, Nutrients, DO, BOD
2720	Alachua Sink	Nutrients
2738	Lochloosa Lake	Nutrients
2754	Cross Creek	Nutrients, DO, BOD
2837	Lake Carlton	Nutrients, unionized ammonia
2740C	Ocklawaha River above Lake Ocklawaha	Nutrients, DO
2740F	Ocklawaha River/Sunnyhill	Nutrients, DO, BOD

2. **EPA TMDL Endpoints (i.e., Targets)**
   Coliforms: 400 counts/100ml and 800 counts/100mL (fecal); 2400 counts/100mL (total)
   Selenium: 5 ì g/L
   Iron: 1.0 mg/L
   Silver: 0.07 ì g/L

3. **Fecal Coliform Allocation (counts/day):**

WBID	$WLA_{Continuous}$	WLA_{MS4}	LA	TMDL	Reduction
2688	0	83% reduction	1.38 x10^{11}	1.38 x10^{11}	83%
2769	0	-	73% reduction	73% reduction	
2740D	0	-	5.27 x10^{11}	5.27 x10^{11}	49%
2817A	0	-	1.63 x10^{12}	1.63 x10^{12}	73%

4. **Total Coliform Allocation (counts/day):**

WBID	$WLA_{Continuous}$	WLA_{MS4}	LA	TMDL	Reduction
2698	0	35% reduction	2.43×10^{11}	2.43×10^{11}	35%
2711	2.27×10^{11}	62% reduction	62% reduction	62% reduction	
2740F	0	-	2.1×10^{12}	2.1×10^{12}	43%
2817A	0	-	4.9×10^{12}	4.9×10^{12}	73%

5. Selenium Allocation:

WBID	WLA	LA	TMDL
2838A	0	62% reduction	62% reduction
2740C	0	63% reduction	63% reduction

6. Iron Allocation:

WBID	WLA	LA	TMDL
2769	0	32% reduction	32% reduction

7. Silver Allocation:

WBID	WLA	LA	TMDL
2740C	0	55% reduction	55% reduction
2831B	0	65% reduction	65% reduction

8. Specific allocations for TMDLs developed by FDEP are contained in Appendices D through H.

9. Endangered Species (yes or blank): yes

10. EPA Lead on TMDL (EPA or blank): EPA

11. TMDL Considers Point Source, Nonpoint Source, or both: Both

12. Major NPDES Discharges to surface waters addressed in EPA TMDLs

Facility Name	NPDES No.	Facility Type	Impacted Stream
John R. Kelly Generating Station	FL0026646	Industrial Wastewater	Sweetwater Branch
GRU STP Main St. WWTP	FL0027251	Domestic WWTP	Sweetwater Branch
Feldspar Corp. EPK Clay Division	FL0028525	Industrial Wastewater	Ocklawaha River
Gainesville/Alachua MS4		Stormwater	Hogtown Creek, Sweetwater Branch
Florida Department of Transportation's Fairbanks facility	FL0169871	Watsewater	Hatchet Creek

TOTAL MAXIMUM DAILY LOAD (TMDL)
OCKLAWAHA RIVER BASIN (HUC 03080102)

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework DEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Ocklawaha Basin is a group 1 basin, first assessed in 2000 with plans to revisit water management issues in 2005. FDEP established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. The Ocklawaha Basin is in the St. Johns River Water Management District (SJRWMD).

For the purpose of planning and management, SJRWMD divided the Ocklawaha Basin into eight planning units: Lake Apopka, Palatalakaha River, Lake Griffin Unit, Lake Harris Unit, Marshall Swamp Unit, Florida Ridge Unit, Rodman Reservoir Unit, and Orange Creek. A planning unit is either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. These planning units contain smaller, hydrological based units called drainage basins, which are further divided into "water segments". A water segment usually contains only one unique waterbody type (stream, lake, cannel, etc.) and is about 5 square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified numerous WBIDs in the Ocklawaha River Basin as not supporting water quality standards (WQS). After assessing all readily available water quality data, EPA is responsible for developing TMDLs in 12 WBIDs (see Table 1). The pollutants of concern addressed in these TMDLs are: fecal and total coliform bacteria, iron, silver, selenium, and nutrients. The TMDLs addressed in this document are shown in Figure 1. The TMDLs addressed in this document are being established pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

Table 1. TDMLs Developed By EPA in Ocklawaha Basin

WBID	Name	Planning Unit	Parameter of Concern
2688	Hatchet Creek	Orange Creek	Fecal Coliform
2698	Hogtown Creek	Orange Creek	Total Coliform
2711	Sweetwater Branch	Orange Creek	Total Coliform
2740C	Ocklawaha River above Lake Ocklawaha	Rodman Reservoir	Selenium, Silver
2740D	Ockawaha River above Daisy Creek	Rodman Reservoir	Fecal Coliform
2740F	Ocklawaha River/Sunnyhill	Rodman Reservoir	Total Coliform
2769	Daisy Creek	Rodman Reservoir	Fecal Coliform, Iron
2817A	Haines Creek Reach	Lake Griffin	Fecal and Total Coliform
2838A	Lake Harris	Lake Harris	Selenium
2717	Kanapaha Lake	Orange Creek	Nutrients
2831B	Lake Dora	Lake Harris	Silver

Waters in the Ocklawaha River Basin are designated as Class III waters having a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The level of impairment is denoted as threaten, partially or not supporting designated uses. A stream that is classified as threaten currently meets WQS but trends indicate the designated use may not be met in the next listing cycle. A stream classified as partially supporting designated uses is defined as somewhat impacted by pollution and water quality criteria are exceeded on some frequency. For this category, water quality is considered moderately impacted. A stream that is categorized as not supporting is highly impacted by pollution and water quality criteria are exceeded on a regular or frequent basis. On these streams, water quality is considered severely impacted.

The format of the remainder of this report is as follows: Chapter 3 is a general description of the Ocklawaha River watershed; Chapter 4 describes the water quality standard and target criteria for the TMDLs; Chapter 5 describes the development of the coliform TMDLs; Chapter 6 describes the development of the metal TMDLs; and Chapter 7 describes the development of the nutrient TMDL for Kanapaha Lake. Chapters 3 and 4 are general and apply to all parameters. Each chapter on the specific TMDLs is a section detailing the data assessment, source assessement, TMDL development and margin of safety.

In addition to the TMDLs listed in Table 1, EPA is proposing TMDLs developed by FDEP for the following pollutants and waterbodies: total coliform in Ocklawaha River above Daisy (WBID 2740D); nutrients in Alachua Sink (WBID 2720); nutrients and dissolved oxygen (DO) in Cross Creek (WBID 2754); nutrients in Lochloosa Lake (WBID 2738); nutrients in Lake Carlton (WBID 2837); nutrients, DO, and biochemical oxygen demand (BOD) in Ocklawaha River above Daisy Creek (2740D), nutrients and DO in Ocklawaha River above Lake Ocklawaha (WBID 2740C), and nutrients, DO and BOD in Ocklawaha River/Sunnyhill (WBID 2740F). These TMDLs are located in Appendices D through H. The Cross Creek and Lochloosa Lake TMDLs are included in one report in Appendix F; the Ocklawaha River TMDLs are included in one report in Appendix H.

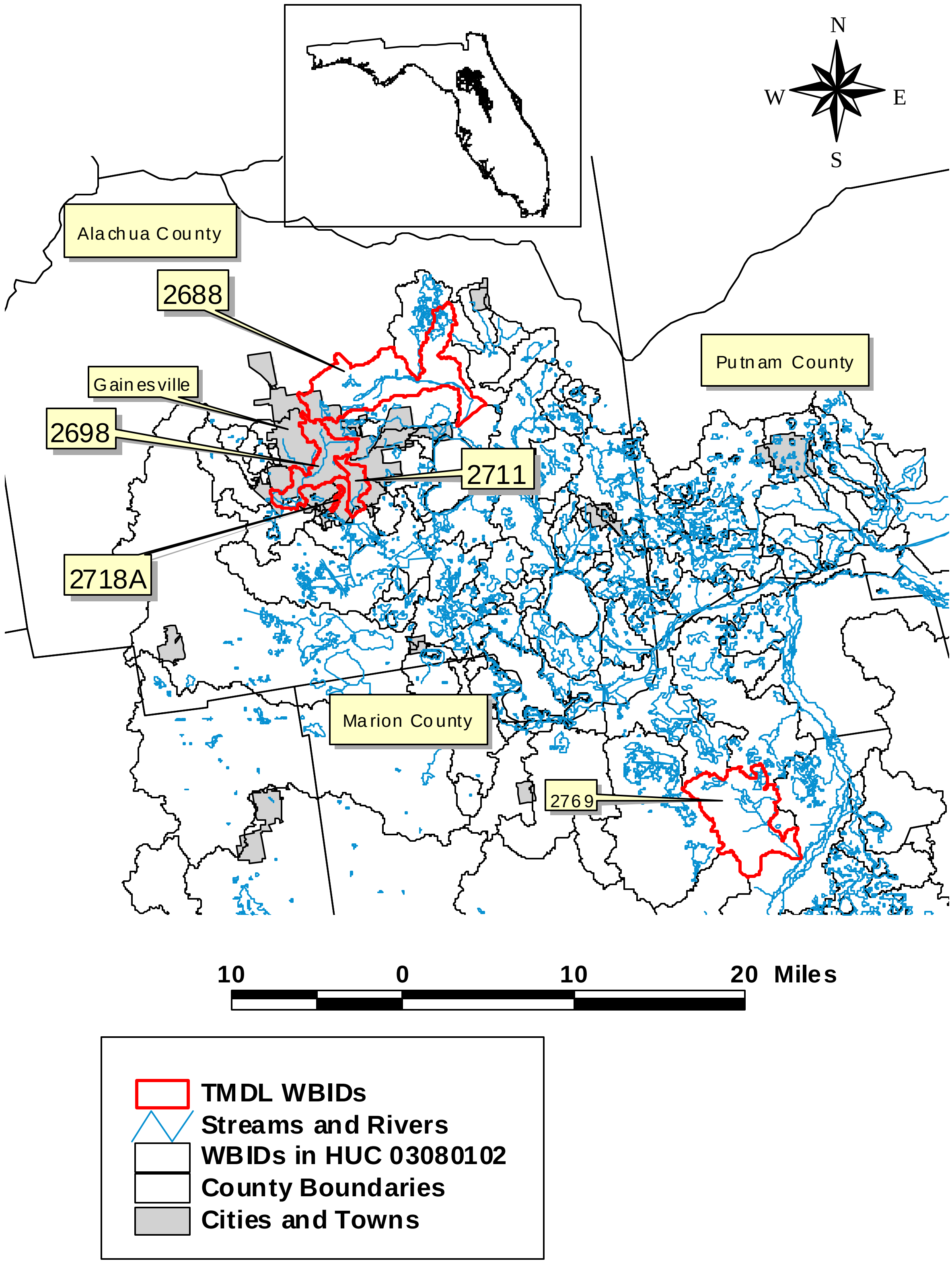


Figure 1. Location of WBIDs in Upper Portion of Ocklawaha Basin

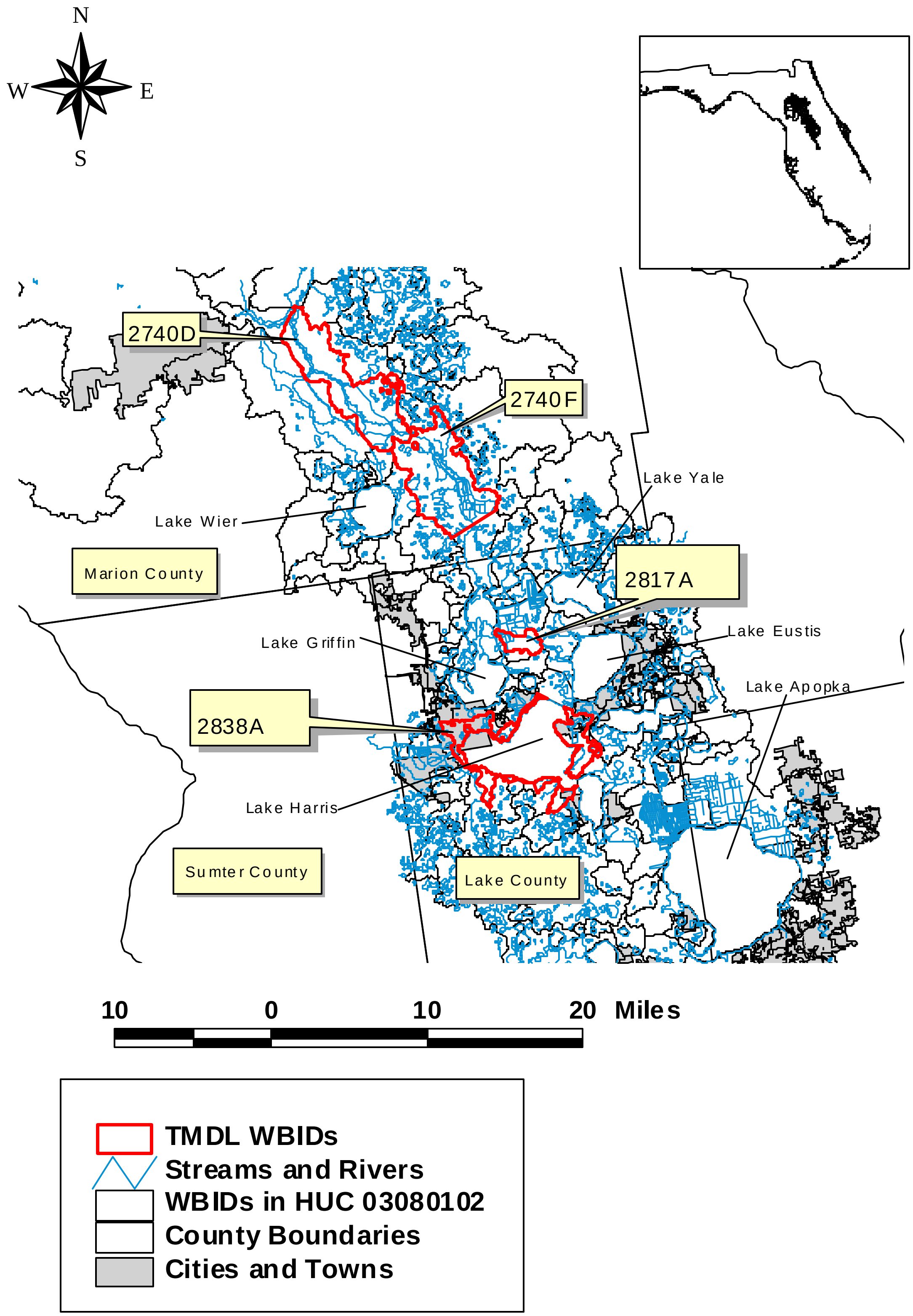


Figure 2. Location of WBIDs in Lower Ocklawaha River Basin

3. WATERSHED DESCRIPTION

The Ocklawaha Basin covers 2,769 square miles of the central to northern portion of Florida, encompassing parts of Alachua, Marion, Orange and Lake Counties. The Ocklawaha River is the largest tributary of the St. Johns River. USGS Hydrologic Unit Code (HUC) 03080102 defines the basin watershed. The following description of the watershed is from the Ocklawaha Basin Status Report (FDEP, 2001). This document should be consulted for additional details.

The Ocklawaha Basin is composed of two hydrologic distinct parts. The Ocklawaha River and its associated lakes and tributaries occupy the eastern half and northern portions of the basin, comprising a defined, connected surface drainage system. Interstate 75 approximates the western boundary of the surface drainage system. Dominant features of the surface drainage system are large, connected lakes and wetlands. Within a chain of lakes, water quality problems that occur in one lake can easily be transferred to the other lakes.

The area west of Interstate 75, the Florida Ridge, is the second hydrologic part of the basin. It is largely an internally drained area with little developed, connected surface hydrology, but rather a well-developed ground water system. The WBIDs impaired by fecal coliform bacteria addressed in this document are in the eastern portion of the basin as shown in Figure 1. All of the impaired WBIDs addressed in this document discharge to the Ocklawaha River or to lakes that discharge to the Ocklawaha with the exception of Hogtown Creek and Sweetwater Branch. The later two waterbodies are closed basins that discharge to the ground water system through sinkholes.

The Ocklawaha River is one of the oldest rivers in Florida, located in the Central Highlands geomorphic region of the Florida peninsula. The Central Highlands are characterized by a series of relict beach ridges and valleys. Distinct ridges and valleys comprise different geomorphic subdivisions of the Central Highlands. The largest feature is the Central Valley occupied by the Ocklawaha River, the Upper Ocklawaha Chain of Lakes, and Lake Apopka. Most of the Central Valley is underlain by sand with minor amount of silt and clay that acts as a veneer over the underlying limestone bedrock.

The Ocklawaha basin is capped to the north by the Northern Highlands. This province has a distinct scarp feature (Cody Scarp). The Cody Scarp runs just north of Newnan Lake and across the southern limits of the city of Gainesville. Karst topography is well developed in this area and it in not unusual for surface streams to disappear into ground water.

Historically, land cover in the basin was primarily agriculture (i.e., citrus farms) and navigation. Draining wetlands around upper basin lakes and Ocklawaha River to expose rich organic soils valuable for growing crops created muck farms in the basin. The muck farms were lower than their adjacent waterbodies, and required that water be pumped off the farmlands into those waterbodies. The pumped water carried excess nutrients, sediments and pesticides and has contributed to declines in water quality. Sunnyhill Farms (WBID 2740F) is a former muck farm and site of a wetland and riverine restoration project.

Land cover for the WBIDs covered in this report is based on the National Land Cover Dataset (NLCD) of 1995, and tabulated in Table 2. Forested land, including planted pine plantations, account for the majority of the land use in the impaired WBIDs. Urban areas around Gainesville dominate land use in the Hogtown Creek and Sweetwater Branch WBIDs. Lakes, streams, wetlands, and springs occupy about 24 percent of the total Ocklawaha basin area.

Table 2. Land Cover Distribution[1] (acres)

WBID	Residential		Commercial, industry, public		Agriculture		Rangeland		Forest		Water		Wetlands		Barren & extractive		Transportation and utilities		Total Area
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
2688	416	2	85	0	578	3	1144	7	11986	69	21	0	1753	10	1399	8	85	0	17466
2698	3381	54.4	1319	21.2	7	0.1	5	0.1	607	9.8	19	0.3	724	11.6	24	0.4	133	2.1	6219
2711	929	43.8	665	31.4	16	0.8	43	2.0	233	11.0	11	0.5	123	5.8	0	0.0	100	4.7	2121
2718A	755	40.7	624	33.7	0	0.0	22	1.2	220	11.9	22	1.2	138	7.4	0	0.0	72	3.9	1854
2740C	1153	3.8	51	0.2	1733	5.7	341	1.1	17285	56.9	302	1.0	9504	31.3	24	0.1	5	0.0	30400
2740F	1051	6.1	3236	18.8	2541	14.7	880	5.1	3710	21.5	1089	6.3	4546	26.4	179	1.0	20	0.1	17252
2749	1367	8.4	102	0.6	3614	22.2	169	1.0	4431	27.3	22	0.1	6490	39.9	0	0.0	67	0.4	16261
2769	1021	7.1	183	1.3	745	5.1	342	2.4	10486	72.4	103	0.7	1511	10.4	0	0.0	89	0.6	14479
2817A	174	8.7	65	3.3	576	29.0	59	3.0	356	17.9	313	15.8	445	22.4	0	0.0	0	0.0	1988
2831B	2026	32.8	808	13.1	623	10.1	1050	17.0	167	2.7	215	3.5	1181	19.1	91	1.5	17	0.3	6177
2838A	1852	19.1	1248	12.9	2120	21.9	1274	13.2	527	5.4	422	4.4	2124	22.0	41	0.4	63	0.6	9670

Notes:

1. Acreage represents the land use distribution in the impaired WBID and not the entire drainage area.
2. Public lands include urban and recreational areas.
3. Rangeland includes shrubland, grassland, and herbaceous land covers.

4. Data source is land cover of 1995 from the St. Johns Water Management District with the exception of WBID 2688 where the data source is NLCD of 1995.

4. WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Waterbodies in the Ocklawaha River Basin are classified as Class III waters, with a designated use classification for recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters, are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. The specific criteria are as follows:

Fecal Coliform Bacteria

The most probable number (MPN) or membrane filter (MF) counts per 100 ml of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

When flow data are available in the WBID, the fecal coliform TMDLs are expressed as daily loads in units of counts per day. The target for the daily loads is either the one-day maximum criteria of 800 counts/100ml or the dual standard of 10 percent of the samples can have concentrations exceeding 400 counts/100ml. The standard resulting in the highest percent reduction is used for the final TMDL calculation.

The fecal coliform TMDLs are also expressed in terms of the percent reduction required to achieve water quality standards. When flow data are not available in the WBID or due to geologic conditions it is not possible to estimate flow (i.e., karst geologic formation), the TMDLs are expressed only as percent reductions. The percent reduction is calculated using both the 400 and 800 criteria. The percent reduction in the TMDL reflects the criteria resulting in the highest reduction.

It is appropriate to use the dual acute criteria for fecal coliform TMDL development because the data indicates violations of the standard are typically related to storm events, which are short-term in nature. Violations of the chronic criteria are typically associated with point sources or non-point source continuous discharges (e.g., leaking septic systems) and typically occur during all weather conditions. Targeting the acute criteria should be protective of the geometric mean criteria (i.e., chronic criteria).

Total Coliform Bacteria

The MPN per 100 ml of total coliform bacteria shall be less than or equal to 1,000 as a monthly average nor exceed 1,000 in more than 20 percent of the samples examined during any month, and less than or equal to 2,400 at any time. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

The target for the total coliform TMDLs is the one-day maximum concentration of 2400 counts/100mL, as less than 10 samples were collected in a 30-day period to determine violations of the not to exceed percentage criterion or the geometric mean. Total coliform bacteria generally indicate the presence of soil-associated bacteria and result from natural influences on a water body such as rainfall runoff as well as sewage inflows (i.e., acute conditions). By protecting the acute criteria (i.e., one-day maximum) bacteria concentrations in the stream should meet the chronic criteria.

Iron

The Iron criterion is that in no case shall concentrations exceed 1.0 milligram/L (mg/l).

Selenium

The Selenium criterion is less than or equal to 5.0 micrograms/L (ì g/l).

Silver

The Sivler criterion is less than or equal to 0.07 micrograms.L ((ì g/l).

5. FECAL AND TOTAL COLIFORM TMDLS

This section of the report details the development of coliform TMDLs in 8 WBIDs in the Ocklawaha River Basin. Section 2 identifies these waterbodies and the parameter of concern. Fecal coliforms are a subset of the total coliform group and indicate the presence of fecal material from warm-blooded animals. Total coliform bacteria generally indicate the presence of soil-associated bacteria and result from natural influences on a water body such as rainfall runoff as well as sewage inflows.

5.1 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

FDEP maintains ambient monitoring stations throughout the basin. In addition, Alachua County collects coliform data as required in the Alachua County Water Quality Code for protecting the environment. Monitoring stations with the most data are used in the development of coliform TMDLs. However, for several of the WBIDs, samples are collected once or twice at several locations in the waterbody. For these TMDLs, all of the data collected in the waterbody are used in the analysis (see Table 3). Tables 4 and 5 provide a statistical summary of the data and include the percent of samples that deviate from the target. A listing of all monitoring stations, measured coliform concentrations, and graphics showing the data with respect to the target are in Appendix A.

Table 3. Monitoring Stations used in the Development of Coliform TMDLs

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
2688 (Hatchet Creek)	21FLSJWM02240800	Fecal Coliform	8/28/95 – 6/3/98	22
2698 (Hogtown Creek)	21FLGW 7480	Total Coliform	6/27/00	1
	21FLGW 7451	Total Coliform	6/26/00	1
	21FLACEPHOGTOWN CR 4	Total Coliform	8/10/94 7/18/95	2
	21FLGW 7463	Total Coliform	6/7/00	1
2711 (Sweetwater Br)	21FLGW 7467	Total Coliform	6/8/00	1
	SWB SE1	Total Coliform	3/12/03	1
	SWB NE10	Total Coliform	3/12/03	1
2740D (Ocklawaha R above Daisy)	21FLSJWM20020001	Fecal Coliform	7/12/94 – 6/17/98	21
2740F (Ocklawaha River/Sunnyhill)	21FLCEN 20020306	Total Coliform	7/12/94 - 4/9/02	6
2769 (Daisy Cr)	21FLSJWM20020146	Fecal Coliform	7/17/02 – 6/23/03	3

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
	21FLSJWM20020118	Fecal Coliform	7/17/02 – 6/23/03	3
2769 (Daisy Cr)	21FLSJWM20020026	Fecal Coliform	7/17/02 – 6/23/03	3
	21FLSJWM20020025	Fecal Coliform	7/17/02 – 6/23/03	3
2817A (Haines Creek Reach)	21FLSJWM02238000	Total Coliform	7/5/95 - 6/17/98	29
	21FLSJWM02238000	Fecal Coliform	7/5/95 - 6/17/98	23

Table 4. Summary of Fecal Coliform Monitoring Data

WBID	Number of Samples	30-Day Geometric Mean[1]	% Samples > 400 (counts/100mL)	% Samples > 800 (counts/100ml)	Minimum Concentration (counts/100mL)	Maximum Concentration (counts/100mL)
2688		N/A	24	8	2	4800
2740D		N/A	5		20	1200
2769		N/A	33		67	2600
2817A	23	N/A	7	5	2	2400

Notes:

1. N/A = not applicable as less than 10 samples collected within a 30-day period to evaluate this criteria.

Table 5. Summary of Total Coliform Monitoring Data

WBID	Number of Samples	30-Day Geometric Mean	% Samples > 2,400 counts/100mL	Minimum Concentration (counts/100mL)	Maximum Concentration (counts/100mL)
2698		N/A	60	300	5600
2711		N/A	33	130	17,000
2740F		N/A	33	200	7800
2817A	19	N/A	4	20	5600

Notes:

1. N/A = not applicable as less than 10 samples collected within a 30-day period to evaluate this criteria.

5.2 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliform bacteria in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of coliform.
Non-point sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off as a result of storm events. Typical non-point sources of coliform include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

The Watershed Characterization System (WCS), a geographic information system (GIS) tool, was used to display, analyze, and compile available information to characterize potential bacteria sources in the impaired watersheds. This information includes land use categories, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

5.2.1 Point Sources

There are a number of point sources located in the drainage areas of the 303(d) listed stream segments that possess NPDES permits for discharges of treated sanitary wastewater; however, most of these facilities discharge to percolation ponds, sprayfields, or deep injection wells. A wasteload allocation (WLA) is given only to NPDES facilities discharging to surface waters. These facilities are listed in Table 6. A review of permit conditions provided in EPA's Permit Compliance System (PCS) database (www.epa.gov/enviro) indicates these facilities have permit limits for fecal coliform bacteria only. A query of this database did not report any permit violations from the facilities listed in Table 6. Based on this information effluent discharging from the facilities do not appear to cause or contribute to impairment in the listed WBIDs. Although the NPDES facilities are not given concentration limits for total coliform, these facilities have reasonable potential to discharge total coliform. For this reason, the NPDES facilities are given a WLA for total coliform based on the one-day maximum criterion of 2400 counts/100ml and a WLA based on the geometric mean criterion.

The coliform WLAs are calculated as both a maximum one-day load and a monthly average load using the facility's design flow and permit concentrations. The WLA expressed as counts/day represents the maximum load the facility can discharge on any one day during a 30-day period. A footnote to Table 7 expresses the WLA in terms of the maximum monthly load in units of counts/30 days. The WLA is calculated using Equation 1.

WLA = flow * concentration * conversion factor (Equation 1)
Where: flow = mgd
concentration = 800 counts/100ml (fecal daily max); 200 counts/100ml (fecal monthly average); 2400 counts/100ml (total daily max); 1000 counts/100ml (total monthly average)
conversion factor = (10^6 gal * 3.785 L/gal * 1000 ml/L) / 100 ml = 3.785×10^7

Municipal Separate Storm Sewer Systems (MS4s) may also discharge bacteria to waterbodies in response to storm events. Currently, large and medium MS4s serving populations greater than 100,000 people are required to obtain a NPDES storm water permit. In March 2003, small MS4s serving urbanized areas will be required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. Currently, the City of Gainesville is the only Phase II municipality covered under the NPDES Storm Water Program impacting coliform TMDLs addressed in this report.

The WLA for the MS4 is expressed in terms of percent reduction. Given the available data, it is not possible to estimate loadings in units of counts/day coming exclusively from the MS4 area. Although the aggregate wasteload allocation for storm water discharges is expressed in numeric form, percent reduction, based on the information available today, it is infeasible to calculate numeric WLAs for individual storm water outfalls because discharges from these sources can be highly intermittent, are usually characterized by very high flows occurring over relatively short time intervals, and carry a variety of pollutants whose nature and extent varies according to geography and local land use. For example, municipal sources such as those covered by this TMDL often include numerous individual outfalls spread over large areas. Water quality impacts, in turn, also depend on a wide range of factors, including the magnitude and duration of rainfall events, the time period between events, soil conditions, fraction of land that is impervious to rainfall, other land use activities, and the ratio of storm water discharge to receiving water flow.

This TMDL assumes for the reasons stated above that it also will be infeasible to calculate numeric water quality-based effluent limitations for coliform for storm water discharges. Therefore, in the absence of information presented to the permitting authority showing otherwise, this TMDL assumes that water quality-based effluent limitations for storm water sources of coliforms derived from this TMDL can be expressed in narrative form (e.g., as best management practices), provided that (1) the permitting authority explains in the permit fact sheet the reasons it expects the chosen BMPs to achieve the aggregate wasteload allocation for these storm water discharges; and (2) the state will perform ambient water quality monitoring for coliform expressed as counts/day for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the LA. The percent reduction calculated for non-point sources is assigned to the MS4 as violations from both sources typically occur in response to storm events. A WLA is given for both fecal and total coliform as reasonable potential exists for the MS4 to discharge both of these parameters.

Table 6. NPDES Facilities Discharging in the Watersheds of Impaired Waterbodies

	GRU STP Main Street WWTP	Feldspar Corp.	Golden Gem Growers/Processors	City of Gainesville MS4
NPDES No.	FL0027251	FL0028525	FL0001066	
Impacted WBID	2711		2807	2698, 2711
Discharge Point	Sweetwater Br	Cabbage Cr	Lake Yale	Several streams
Design Flow (mgd)	7.5	8.18	2	Storm dependent
WLA (fecal coliform, counts/day)[1]	Information provided in FDEP TMDL for Sweetwater Branch	N/A	N/A	
WLA (total coliform, counts/day)[3]	6.81×10^{11}	N/A	N/A	

Notes:

1. WLA for fecal coliform represents maximum daily load based on facility design flow and one-day maximum permit concentration of 800 counts/100mL.
2. N/A means facility does not have permit limits for coliforms and do not have reasonable potential to discharge coliform.
3. Monthly total coliform WLA is: $7.5 * 1000*3.785 \times 10^{7} * 30\text{day} = 8.52 \times 10^{12}$ counts/30days

5.2.2 Non-point Sources

5.2.2.1 Wildlife

Wildlife deposit bacteria with their feces onto land surfaces where it can be transported during storm events to nearby streams. The bacteria load from wildlife is assumed background, as the contribution from this source is small relative to the load from urban and agricultural areas. In addition, any strategy employed to control this source would probably have a negligible impact on obtaining water quality standards.

5.2.2.2 Agricultural Animals

Agricultural animals are the source of several types of coliform loadings to streams. Agricultural activities including runoff from pastureland and cattle in streams impact water quality. Livestock data from the 1997 Census of Agriculture for the counties encompassing the impaired WBIDs are listed in Table 7. Cattle, including beef and dairy cows, is the predominate livestock in these counties. In Lake County, horses represent a significant portion of the livestock. Confined Animal Feeding Operations (CAFOs) are not known to operate in the impaired WBIDS. The US Department of Agriculture (USDA) is currently in the process of updating the agricultural census for 2002. Data from the 2002 Census will be released in Spring 2004.

Table 7. Livestock Distribution by County (source: NASS, 1977)

Livestock (inventory)	Alachua	Marion	Lake	Putnam
Cattle and calves	49,567	51,792	34,442	9,010
Beef Cows	27,324	27,867	17,693	(D)
Dairy Cows	3,341	3,819	2,577	(D)
Swine	1,292	2,509	414	531
Poultry (broilers sold)	(D)[1]	(D)	58	(D)
Sheep	716	628	232	11
Horses and Ponies	1,731	17,205	1,461	353

Notes: (D) – data withheld to avoid disclosing data for individual farms

5.2.2.3 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. Table 8 summarizes the number of septic systems by county and provides estimates of countywide failure rates and total daily discharge of wastewater from septic tanks.

Table 8. County Estimates of Septic Tanks (FDEP, 2001)

County	Number of Septic Tanks[1]	Percent of 1995 Population Using Septic Tanks[2]	Failure Rate per 1000[3]	Estimated Discharge (MGD)[4]
Alachua	37,208	32.7	9.67	5.02
Marion	96,622	61.3	9.57	13.04
Lake	63,656	50.1	11.81	8.59
Putnam	36,649	80.4	4.61	4.95

Notes:
1. Total number per county is based on 1970 census figures plus the number of systems installed since 1970 through June 30, 2000. Numbers do not reflect the removal of septic systems by connection to central sewers.
2. Source: St. Johns River Water Management District, May 2000, p. 97, cited in FDEP, 2001.
3. Defined as the number of repairs divided by the number of installed systems for July 1, 1999 to June 30, 2000.
4. Based on value of 135 gallons per day per tank (FDEP, 2001).

5.2.2.4 Urban Development

Fecal coliform loading from urban areas is attributable to multiple sources including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, Florida Administrative Code (F.A.C.).

The rule requires Water Management Districts (WMD) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. St. Johns River Water Management District has developed PLRG for seven major lakes in the Upper Ocklawaha River basin. This PLRG addresses nutrient loads generated from stormwater runoff (SJWMD, 2003).

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5)(c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's stormwater programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased stormwater peak discharge rate, volume, and pollutant loadings that accompany urbanization.

5.3 Analytical Approach

The approach for calculating coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, the TMDL is expressed as a percent reduction. When limited water quality or flow data are available a mass balance approach is used to calculate the TMDL. Load duration curves are used to develop TMDLs when significant data are available to develop a relationship between flow and concentration. For the load duration curve TMDLs, the target is the acute criteria. The approach and the target used to develop the coliform TMDLs are listed in Table 9. Details pertaining to the analytical approach are included in Appendix B. For fecal coliform, the percent reduction is calculated using both the 400 and 800 criteria, and the criteria resulting in the highest reduction is selected as the TMDL.

Table 9. Approach for developing coliform TMDLs in Ocklawaha Basin

Listed Waterbody	Parameter	Approach
Hatchet Creek (2688)	Fecal Coliform	Mass balance
Hogtown Creek (2698)	Total Coliform	Load duration curve
Sweetwater Branch (2711)	Total Coliform	Percent reduction
Ocklawaha R above Daisy (2740D)	Fecal Coliform	Load duration curve

Listed Waterbody	Parameter	Approach
Ocklawaha R/Sunnyhill (2740F)	Total Coliform	Load duration curve
Daisy Creek (2769)	Fecal Coliform	Percent reduction
Haines Creek Reach (2817A)	Total Coliform	Load duration curve
Haines Creek Reach (2817A)	Fecal Coliform	Load duration curve

5.3.1 Mass Balance Approach for TMDL Development

The mass balance approach for TMDL development is based on the conservation of mass principle as defined in Equation 2. This equation is used to calculate loads in both the mass balance and load duration curve approaches for TMDL development.

Load = Concentration * Flow * Conversion Factor (Equation 2)

Where: Load = counts/day
Flow = cfs
Concentration = counts/100mL
Conversion Factor = (28.247 L/cf * 86400 sec/day * 1000mL/L)/100mL

For existing conditions, the sample concentration and an estimate of flow on the day of sampling is used to calculate the load. The applicable water quality criterion is the concentration used to calculate the allowable load. If a USGS flow gage operates in the WBID a flow duration curve is developed and the flow at various duration intervals is used to estimate the allowable load. Flow duration curves are explained in Section 5.3.2. Flows on ungaged streams can be extrapolated using a drainage area ratio or some type of regression analysis. In accordance with USGS protocols, the drainage area method can be used to estimate flows when the drainage area for the ungage site is within about 0.5 to 1.5 times the drainage area of the gaged site (personal communications, USGS, 2002). Hogtown Creek, Haines Creek Reach, and Ocklawaha River currently have continuous flow gages; however, the water quality monitoring stations do not always coincide with the location of the flow gage. To estimate flow at the monitoring stations gage flow is multiplied by a weighted drainage area ratio of the two sites.

5.3.2 Flow Duration Curves

The first step in developing load duration curves is to create flow duration curves. A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The curve relates flows measured at a monitoring station to a duration interval representing the percent of time flows are equaled or exceeded. Flows are ranked from low, which are exceeded nearly 100 percent of the time, to high, which are exceeded less than 1 percent of the time. Flow duration curves are limited to the period of record available at a gage. The confidence in the duration curve approach in predicting realistic percent load reductions increases when longer periods of record are used to generate the curves. Gages used to develop flow duration curves are shown in Table 10. The flow duration curve for Haines Creek Reach is shown in Figure 2. Flow duration curves for other listed waterbodies are provided in Appendix B.

Table 10. Continuous flow gages located on impaired waterbodies

Stream Name	USGS Gage	Period of Record
Hogtown Creek	02240954	11/19/1971-current
Hogtown Creek	02240950	1998 - 2000
Hatchet Creek	02240950	1/1/1995 – 2/11/2002
Haines Creek Reach	02238000	7/1/1942-current
Ocklawaha River	02238500	10/1/1943-current
Ocklawaha River	02240000	2/13/1930 - current

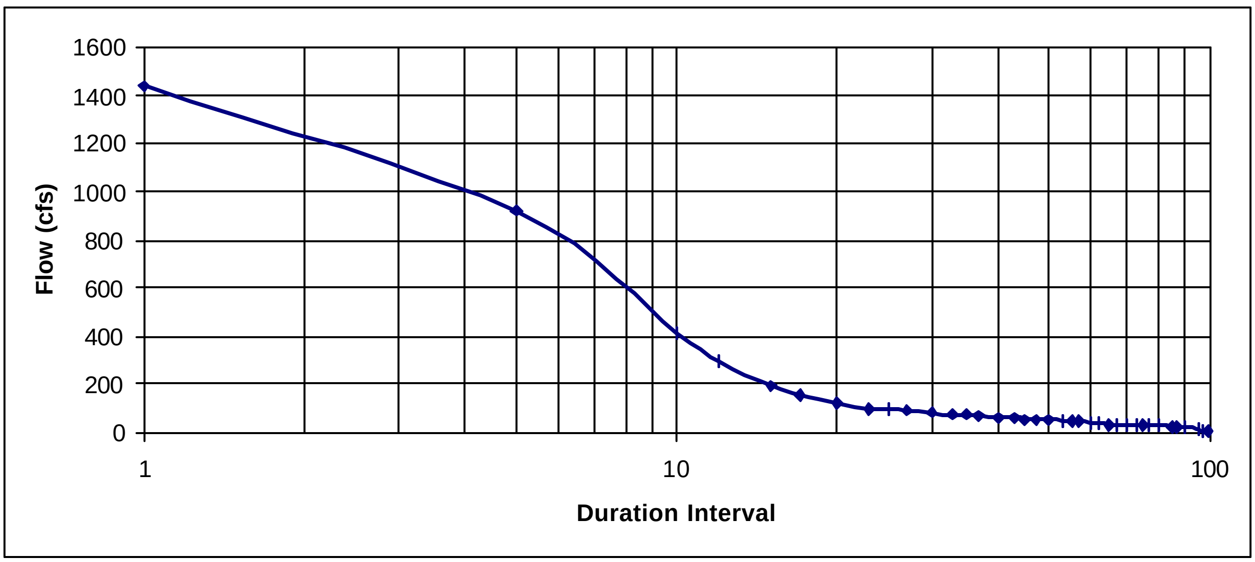
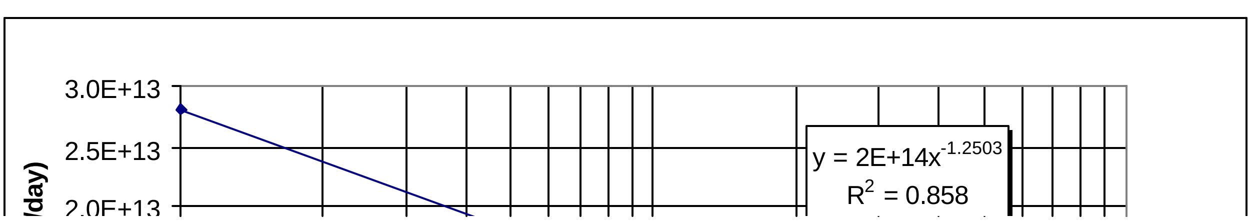


Figure 3. Flow Duration Curve for Haines Creek Reach (USGS 02238000)

5.3.3 Load Duration Curves

Flow duration curves are transformed into load duration curves by multiplying the flow values at each duration interval by the appropriate water quality criterion and a conversion factor. The line through these points is called the target line. Each point on the line represents the allowable load, or TMDL, at each interval. Existing loads are superimposed on the curve based on the duration interval of the flow used to calculate the existing load. Existing loads that plot above the target line indicate a violation of the water quality criterion, while loads plotting below the line represent compliance. The load duration curve for fecal coliform in Haines Creek Reach (WBID 2817A) is shown in Figure 3. Load curves developed for other impaired waterbodies are provided in Appendix B.

Figure 4. Load Duration Curve for Fecal Coliform in Haines Creek Reach (WBID 2817A)



The positioning of monitoring data on the load duration curve provides an indication of the potential sources and delivery mechanisms of the pollutant. In general, violations occurring on the right side of the curve typically occur during low flow events and are indicative of continuous pollutant sources, such as NPDES permitted discharges, leaking collection lines, or leaking septic systems. Livestock having access to streams could also be a source during low flow (livestock are not expected to be in the stream during high flows). Violations that occur on the left side of the curve occur during high flow events. Violations in this range are indicative of sources responding to rainfall events. As shown in Figure 3, water quality violations occur during both mid-flow and high flow events (i.e., flows exceeded between 30 to 90 percent of time). Potential sources in this range are in response to rainfall events when surface runoff and infiltration/interflow dominate.

A trend line is drawn through the data points representing water quality violations. In the load curve application, trend lines are used to predict the load at other duration intervals. The type of line drawn through the data can have several shapes, ranging from linear (simplest form) to moving average. The type of the line chosen should result in a relatively high correlation factor, denoted by the variable R^2. The correlation factor provides an indication of how well the equation of the line represents the data. In general, high correlation factors are not associated with environmental data.

5.4 Development of Total Maximum Daily Loads

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. TMDLs for the impaired waterbodies are expressed in terms of a percent reduction, and where possible, as loads in units of counts per day. When expressed as a load, the TMDL value represents the maximum one-day load the stream can transport over a 30-day period and maintain the water quality standards.

5.4.1 Critical Conditions

The critical condition for non-point source coliform loading is an extended dry period followed by a rainfall runoff event. During the dry weather period, coliforms build up on the land surface, and are washed off by rainfall. The critical condition for point source loading occurs during periods of low stream flow when dilution is minimized. Water quality data have been collected during both time periods. Most violations occur during median to high flow conditions.

Critical conditions are accounted for in the load curve analysis by using the entire period of record of measured flows and all water quality data available for the stream. When continuous gages were not operational in a WBID, the expected range of flows in these streams was estimated using a weighted drainage area ratio.

5.4.2 Existing Conditions

Existing conditions are based on the instream water quality violations. When only a few samples exceed the numerical criterion, existing loads are based on the average values of the violations.
In the load curve approach, the trend line equation is used to calculate the existing load at each duration interval. The loads between the 10th and 90th duration interval were averaged to obtain a single value. Flows occurring less than 10 percent of the time were considered extreme flood conditions while flows occurring greater than 90 percent of the time were considered extreme drought conditions. Extreme flow conditions were not considered in the TMDL analysis.
Using the trend line equation for fecal coliform in Haines Creek Reach (see Figure 4), the calculated existing load between the 10th and 90th percentile ranges between 7.21×10^{11} and 1.12×10^{13} counts/day. The average of these values, or 2.62×10^{12} counts/day, represents the total existing load in the stream. Details on this calculation as well as calculations of existing loads for the other impaired streams are provided in Appendix B.

5.5 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In the Ocklawaha Basin TMDLs an implicit MOS was used. For TMDLs developed using load curves, the assumption that reductions are needed at all flows between the 10th and 90th duration interval results in percent reductions higher than what is required based on observed data violations. In the mass balance approach, the maximum concentration measured instream is used in the calculations and this results in a conservative estimate of the reduction needed to attain standards.

5.5.1 Determination of TMDL, WLAs, & LAs

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards. The TMDLs are based on the one-day maximum concentration of the parameter as specified in the Class III WQS and are expressed in units of counts per day. The TMDL value is reduced by the WLA, if any, to obtain the LA component. TMDL components for the impaired waterbodies as well as the percent reduction required to achieve the numerical criterion are provided in Table 11.

Table 11. Coliform TMDL Components

Stream Name	Parameter	WLA[1]		LA (Counts/day)	TMDL[2] (Counts/day)	Percent Reduction[3]
		Continuous (counts/day)	MS4			
Hatchet Creek	Fecal Coliform	0	83% reduction	1.38×10^{11}	1.38×10^{11}	83%
Hogtown Creek	Total Coliform	0	35% reduction	2.43×10^{11}	2.43×10^{11}	35%
Sweetwater Branch	Total Coliform	$2.27 \text{ X } 10^{11}$ (see note 4)	62% reduction	See note 5	See Note 5	62%
Daisy Creek	Fecal Coliform	0	N/A	See Note 6	See Note 6	73%
Ocklawaha River above Daisy	Fecal Coliform	0	N/A	5.27×10^{11}	5.27×10^{11}	49%
Ocklawaha River/Sunnyhill	Total Coliform	0	N/A	2.1×10^{12}	2.1×10^{12}	43%
Haines Creek Reach	Total Coliform	0	N/A	4.9×10^{12}	4.9×10^{12}	48%
Haines Creek Reach	Fecal Coliform	0	N/A	1.63×10^{12}	1.63×10^{12}	73%

Notes:
1. WLA component separated into load from continuous NPDES facilities (e.g., WWTP) and load from MS4. Continuous discharge facilities have WLA units of counts/day based on permit limits and design flow. MS4 load represented as percent reduction.
2. Margin of Safety is implicit and does not add to the TMDL value.
3. Overall reduction to achieve the most stringent of the acute criteria for fecal coliform and 2400 counts/100ml for total coliform.
4. Monthly WLA for continuous WWTP is 1.7×10^{12} counts/30days.
5. Flow data not available for Sweetwater Branch. TMDL represents average percent reduction from samples collected at 3 locations in the stream (see Appendix B).
6. Flow data not available for Daisy Creek. TMDL represents average percent reduction from samples collected at 4 locations in the stream on 6/23/03 (see Appendix B)

5.5.2 Waste Load Allocations

There are numerous NPDES permitted facilities discharging coliforms to surface waters in the Ocklawaha River Basin; however, most of the facilities discharge to sprayfields or disposal wells. Only facilities discharging directly into streams and MS4 areas are assigned a WLA. The WLAs are expressed separately for continuous discharge facilities (e.g., WWTP) and MS4 areas as the former discharges during all weather conditions whereas the later discharges in response to storm events.

Of the WBIDs addressed in this report, only Sweetwater Branch has a NPDES facility discharging directly into the stream. The GRU STP Main Street WWTP has permit limits that meet instream water quality standards. Based on DMR data permit violations have not been reported, therefore, no reductions are required. Currently, the City of Gainesville/Alachua County is the only Phase I or II MS4 in the WBIDs of concern. The WLA assigned to the MS4 area is expressed in terms of percent reduction of coliform concentration required to attain standards. With the water quality data collected from Alachua County it is not possible to isolate the loading discharging exclusively from the MS4. Any future MS4 located within the watershed boundaries of the impaired streams will be prescribed a WLA based on the percent reduction required in the TMDL.
In Table 11, the WLAs assigned to the continuous discharge facilities (i.e., WWTP) are based on the one-day maximum permit criterion of 800 counts/100mL. These loads represent the maximum one-day load the facility can discharge in any 30-day period and maintain water quality standards. In compliance with permit limits, this facility cannot exceed a monthly average concentration of 200 counts/100mL which is protected by the monthly allocation provided by Note 4 in Table 4. Any future facility permitted to discharge fecal coliform bacteria in the watershed will be required to meet permit limits. Future facilities discharging at concentrations less than the water quality standard should not cause or contribute fecal coliform bacteria impairment in the watershed.

5.5.3 Load Allocations

There are two modes of transport for non-point source fecal coliform bacteria loading into the stream. First, loading from failing septic systems and animals in the stream are considered direct sources to the stream, as they are independent of precipitation. The second mode involves coliform loadings resulting from accumulation on land surfaces transported to streams during storm events.

The positioning of the water quality data values on the load duration curve provide an indication of the mode of transport occurring during periods of violations. For streams in the Ocklawaha River Basin, most violations are distributed on the left side of the curve, indicating violations occur during wet weather events. The LA components represented in Table 11 are calculated as the difference between the TMDL and the WLA components.

5.5.3 Calculation of Percent Reduction

The percent reduction necessary to achieve water quality standards is based on the more stringent of the dual acute criteria. Insufficient data are available to calculate the reduction using the chronic criteria (i.e., geometric mean), but meeting the acute criteria should attain standards during all times. Calculation of the percent reductions for the coliform TMDLs is provided in Appendix B; examples using the fecal coliform TMDLs for Haines Creek Reach and Hatchet Creek are explained below. In the Haines Creek Reach TMDL, the 400 criteria results in the largest percent reduction; whereas in the Hatchet Creek TMDL, the 800 criteria results in the largest percent reduction.

The fecal coliform TMDL for Haines Creek Reach was developed using a load duration curve. The percent reduction is calculated as the average reduction required between the 10th and 90th duration interval. At each interval, the reduction is calculated between the allowable load and the existing load. The allowable load is calculated based on the 800 criteria and the flow at the particular interval. The existing load at each interval is calculated using the trendline equation (see Figure 4 for trendline equation). In the trendline equation the parameter "x" in the equation represents the duration interval and the parameter "y" represents the load. Table 12 details the calculation of the percent reduction for fecal coliform in Haines Creek Reach.

Table 12. Calculation of Percent Reduction using Load Curve Approach for Fecal Coliform in Haines Creek Reach (WBID 2817A)

Interval	Allowable Load (cnts/day)	Exist. Load (cnts/day)	Reduction (percent)
99	1.15E+11	6.40E+11	82.0
95	2.93E+11	6.73E+11	56.5
90	4.45E+11	7.21E+11	38.2
85	5.08E+11	7.74E+11	34.4
80	5.47E+11	8.35E+11	34.5
75	5.66E+11	9.05E+11	37.4
70	6.05E+11	9.87E+11	38.6
65	6.83E+11	1.08E+12	36.9
60	7.81E+11	1.20E+12	34.7
55	8.98E+11	1.33E+12	32.7
50	9.96E+11	1.50E+12	33.7
45	1.11E+12	1.71E+12	35.1
40	1.27E+12	1.99E+12	36.1
35	1.48E+12	2.35E+12	36.8
30	1.68E+12	2.85E+12	41.0
25	1.91E+12	3.57E+12	46.5
20	2.36E+12	4.72E+12	50.0
15	3.75E+12	6.77E+12	44.6
10	8.15E+12	1.12E+13	27.5
5	1.80E+13	2.67E+13	32.8
1	2.81E+13	2.00E+14	85.9
average values between the 90th and 10th percentiles			
Allowable Load (counts/day) :		1.63E+12	
Existing Load (counts/day):		2.62E+12	
Percent Reduction:		37.6	

As shown in Table 4, five samples violated the 800 criteria and seven of the 23 samples violated the 400 criteria. The average reduction necessary to achieve the 800 criteria is about 38 percent (see Table 12). Figure 5 shows the distribution of fecal coliform measurements collected in Haines Creek Reach. As shown in this figure, many of the water quality violations have data qualifiers indicating the sample was held beyond the required holding time. In evaluating the reduction required to achieve the 400 criteria, violations with data qualifiers were not included in the analysis. The sample having the highest concentration without a data qualifier is 1500 counts/100ml. The reduction required to reduce this concentration to 400 counts/100ml is calculated as:

$$\% \text{ Reduction} = (1500 - 400) / 1500 * 100 = 73 \%$$

The reduction required to achieve the 400 criteria is greater than the reduction necessary to achieve the 800 criteria; therefore, the 400 criteria is considered the more stringent of the dual criteria and is selected as the TMDL reduction.

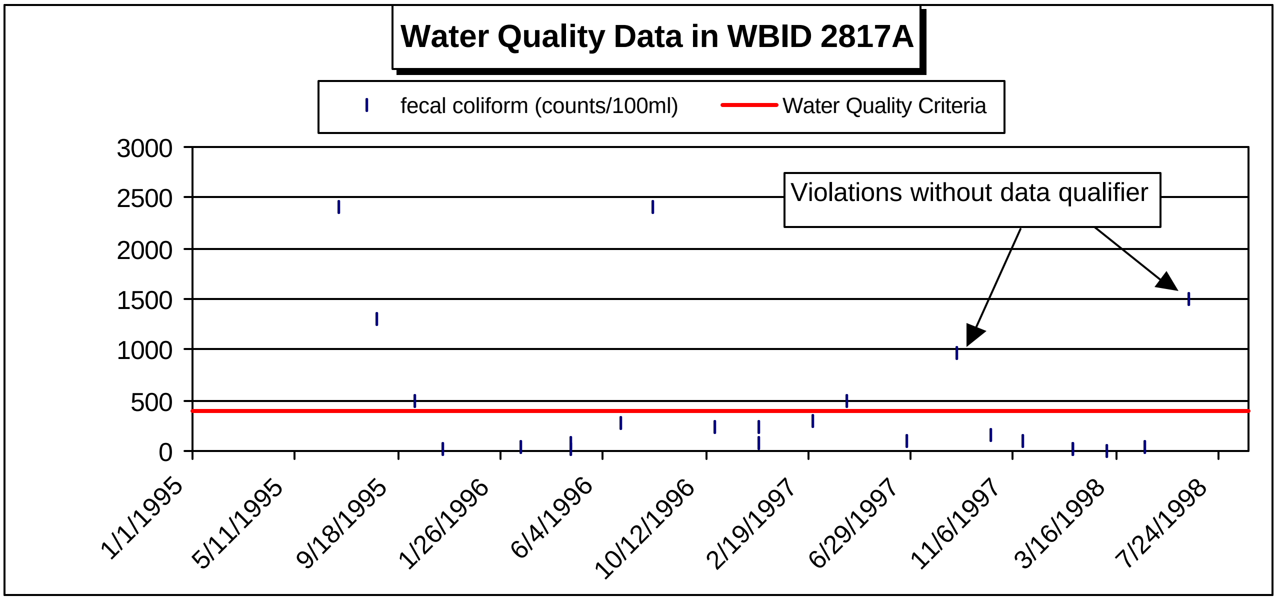


Figure 5. Fecal Coliform Measurements in Haines Creek Reach (WBID 2817A)

In the fecal coliform TMDL for Hatchet Creek, the reduction required to achieve the 800 criteria was more stringent than that to achieve the 400 criteria. Of the samples collected in Hatchet Creek, only one sample with a concentration of 4800 counts/100ml, exceeded the 800 criteria. The reduction required to achieve the 800 criteria is about 83 percent (i.e., (4800-800)/4800 *100 = 83%). In evaluating the 400 criteria, 10 percent of the samples can exceed 400; therefore, two of the 27 samples not having data qualifiers can be excluded from the analysis. By excluding the 2 highest samples violating the 400 criteria, the highest remaining concentration is 500 counts/100ml. A 20 percent reduction in coliform concentration is required to achieve the 400 criteria. Because the 800 criteria results in a greater reduction than the 400 criteria, the basis for the percent reduction is the 800 criteria. By achieving the reduction required using the 800 criteria, standards should be achieved for all other conditions.

5.5.4 Seasonal Variation

Seasonal variation was incorporated in the load curves by using the entire period of record of flow recorded at the gages. Seasonality was also addressed by using all water quality data associated with the impaired streams, which was collected during multiple seasons.

6. METAL TMDLS

This section of the report details the development of a TMDL for: selenium in Lake Harris (WBID 2838A); selenium and silver in the Ocklawaha River Above Lake Ocklawaha (WBID 2740C); iron in Daisy Creek (WBID 2769); and silver in Lake Dora (WBID 2831B). Lake Harris and Lake Dora are located in Lake County, FL and are within the Lake Harris Planning Unit. The Ocklawaha River above Lake Ocklawaha is located in the Rodman Reservoir Planning Unit in Marion County. Daisy Creek is also located in the Rodman Reservoir Planning Unit in Marion County.

The Ocklawaha River discharges into the St. Johns River. Land cover in WBID 2740C is predominantly forest. Urban development is occurring in the northwest portion of the watershed. Table 13 through Table 16 provides a list of water quality monitoring stations in WBID 2740C, 2838A, and 2769, respectively. Each station is identified and the time period of record is given for the individual stations.

Table 13. Water Quality Observation Stations used in Assessment for WBID 2740C

Station	Station Name	First Date	Last Date
11COEJAX3CFB10004	Ocklawaha river at sr 316 (eureka)	02/08/1989	09/25/1990
21FLA 20020012	Ocklawaha river at sr 316	02/27/1989	05/18/1999
21FLA 20020147	Ocklawaha river upstream of piney island landing	12/01/1998	12/01/1998
21FLA 20020148	Ocklawaha river between palmetto landing and sund	12/01/1998	12/01/1998
21FLA 20020149	Ocklawaha river downstream of gore's landing	12/01/1998	12/01/1998
21FLA 20020150	Ocklawaha river downstream of Osceola landing	12/01/1998	12/01/1998
21FLA 20020152	Ocklawaha river downstream of grahams Ville landing	12/01/1998	12/01/1998
21FLA 20020310	Ocklawaha river at gores landing	07/02/1996	07/02/1996
21FLA 20020427	Ocklawaha river at Caldwell landing	02/27/1989	12/01/1998
21FLCEN 20020012	Ocklawaha river at sr 316	01/05/1999	08/06/2002
21FLCEN 20020147	Ocklawaha river upstream of piney island landing	01/05/1999	05/03/1999
21FLCEN 20020148	Ocklawaha river between palmetto landing and sunda	01/05/1999	05/03/1999
21FLCEN 20020149	Ocklawaha river downstream of gore's landing	01/05/1999	05/03/1999
21FLCEN 20020150	Ocklawaha river downstream of Osceola landing	01/05/1999	05/03/1999
21FLCEN 20020152	Ocklawaha river downstream of grahams Ville landing	01/05/1999	05/03/1999
21FLCEN 20020427	Ocklawaha river at Caldwell landing	01/05/1999	05/03/1999
21FLGW 7453	sjd-hs-1015	05/11/2000	05/11/2000
21FLGW 7468	sjd-hs-1098	05/24/2000	05/24/2000
21FLGW 7471	sjd-hs-1121	05/11/2000	05/15/2000
21FLGW 7479	sjr-hs-1066	05/11/2000	05/11/2000
21FLGW 8106	sjd-ls-1031	09/21/2000	09/21/2000
21FLGW 8721	sjd-sl-1024	07/27/2000	07/27/2000
21FLSJWM 20020012	Ocklawaha river at sr 316	01/06/1999	12/03/2001
21FLSJWM ORD	Ocklawaha river downstream sr 40 before 4th river bend	02/22/1999	10/17/2001
21FLSJWM20020012	Ocklawaha river at sr 316	07/05/1995	12/07/1998
21FLSJWMOR316	Ocklawaha river at sr 316	05/17/1993	04/25/1995
21FLSJWMORD	Ocklawaha river downstream sr 40 before 4th river bend	01/11/1994	12/07/1998

Table 14. Water Quality Observation Stations used in Assessment for WBID 2838A

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
2838A	21FLSJWM HAR	Selenium	5/30/95 – 12/11/01	41

Table 15. Water Quality Stations for WBID 2769, Daisy Creek

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
2769	20020146 Daisy Creek at NE 105th Street	Iron	2003	2
2769	20020118 Daisy Creek at SR315	Iron	2003	2

Table 16. Water Quality Stations for WBID 2831B, Lake Dora

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
2831B	21FLSJWMDOR	Silver	11/30/93 – 3/6/95	9

6.1 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

FDEP maintains ambient monitoring stations at several locations throughout the Ocklawaha River Basin. A summary of the metal data as well as the target used to develop the TMDLs is provided in Table 15. A complete listing of metal data collected in the WBIDs is included in Appendix A.

Many of the water quality samples listed in Appendix A have remark codes of "T", "W", or negative values. The T and W codes mean the value reported are less than the detection limit of the method used analyze the sample. Negative concentrations are assumed zero or samples where the parameter is not detected. Samples having these remark codes were not used to develop the TMDL. This assumption is consistent with EPA listing guidelines. In addition, some of the data that was below the laboratory detection limit was modified by FDEP in an attempt to correct the data. Often the laboratory results were reported as negative numbers or very low numbers when below the detection limit. The remark code was one system of keeping track of such conditions, another method was to modify the reported number to 1, 2 or the limit of detection. Therefore, results with appropriate remark codes, negative values, or many values reported as 1 were treated as not detected.

Table 17. Summary of Metal Data

WBID	Parameter	Criteria[1]	No. of Observations	% Samples > Criteria	Minimum Concentration	Maximum Concentration
2838A	Selenium	5 ì g/l	41	24.3	2 ì g/l	72.7 ì g/l
2740C	Silver	0.07 ì g/l	5	100	0.1 ì g/l	0.34 ì g/l
2740C	Selenium	5 ì g/l	51	18	1 ì g/l	4.88 ì g/l

WBID	Parameter	Criteria[1]	No. of Observations	% Samples > Criteria	Minimum Concentration	Maximum Concentration
2769	Iron	1 mg/l	4	100	1180 mg/l	1548 mg/l
2831B	Silver	0.07 ì g/l	9	83	0.01 ì g/l	0.8 ì g/l

Note: Water quality criteria for Class III waters.

6.2 Source Assessment

In the Lake Harris Planning Unit, there are two NPDES facilities discharging industrial wastewater: Silver Springs Citrus (FL0175412) and Dura Stress (FL0171620). Neither of these facilities discharge directly into Lake Harris or Lake Dora. There are no permitted surface water dischargers in WBID 2740C or WBID 2769 (Daisy Creek). There are several non-surface water discharge facilities located in all the impaired WBIDs that discharge to sprayfields and percolation ponds. Non-surface water discharge facilities are regulated by the state permitting program and not through the NPDES program.

Nonpoint sources are the likely source of the elevated metal concentrations. Possible nonpoint sources include runoff from upland agricultural areas, air deposition from industrial facilities, muck farms, and urban runoff. Discharge from the groundwater system (i.e., springs) is another transport mechanism for pollutants; however, it is unlikely that selenium or silver is transported to the impaired lakes through the groundwater system.

6.3 Analytical Approach

The approach for calculating metals TMDLs is based on the numerical water quality standard and the requirement that facility discharges and non-point source runoff meet the standard at the point it enters the stream. Therefore, the TMDL is expressed in terms of percent reduction from the numerical criteria. Existing conditions are based on the average of the data violations. TMDL components for Lake Harris, Ocklawaha River, and Daisy Creek are provided in Table 16. Calculations of the TMDL components are included in Appendix C.

Table 18. Metal TMDL Components

WBID	Parameter	WLA (lbs/day)	LA (% reduction)	TMDL (% Reduction)
2838A	Selenium	0	62	62
2769	Iron	0	32	32
2740C	Selenium	0	63	63
2740C	Silver	0	55	55
2831B	Silver	0	65	65

6.3.1 Waste Load Allocation (WLA)

Since there are no NPDES facilities in the impaired WBIDs, the WLA is zero. Future facilities discharging the parameter of concern will be required to meet end of pipe limits equivalent to the numerical criteria.

6.3.2 Load Allocation (LA)

The load allocation is represented as a percent reduction from the numerical criteria. Without flow data it is not possible to calculate loads.

6.3.3 Margin of Safety (MOS)

The MOS for the selenium and silver TMDLs is implicit. The implicit MOS is based on using end of pipe criteria when additional flow is present in the water body. Since there are no direct discharges to surface water in these WBIDs, and the discharge would only enter the impaired surface water in extreme rainfall events, additional flow would be present. Current data indicate selenium concentrations are lower than historical average and would indicate a smaller percent reduction is needed to attain standards (see Appendix C).

6.3.4 Seasonal Variation

Seasonal variation was incorporated in the TMDLs by using all water quality data associated with the impaired streams, which was collected during multiple seasons. These metals TMDLs are based on the water body meeting the water quality criteria under all seasonal conditions including high and low flow conditions.

7. Nutrient TMDL

This section presents a Total Maximum Daily Load (TMDLs) for nutrients in Kanapaha Lake. The TMDL addressed in this document is being established pursuant to EPA commitments in the 1999 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998) that TMDLs be developed for all of the impairments on the approved 1998 303(d) list.

7.1 Watershed Description

Kanapaha Lake (WBID 2717B) is located southwest of Gainesville in Alachua County (see Figure 6). Kanapaha Lake is in the Hogtown Creek watershed, which is part of the Orange Creek planning unit in the Ocklawaha River Basin. For assessment purposes, the watersheds within the Ocklawaha River Basin have been broken out into smaller watersheds, with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed. Kanapaha Lake has been assigned WBID 2717.

The predominant type of watershed in Alachua County is the stream to sink basin. These are found primarily in the central portion of the county around Gainesville and north to the Alachua/High Springs area. Some of these basins, including the Hogtown Creek watershed, are situated within or near urban development areas. As a result, they are susceptible to the adverse effects of pollutants from urban stormwater runoff. This point is especially critical as these creeks drain into sinkholes that connect to the Floridan Aquifer, the primary drinking water source for the north central Florida region.

As part of the urbanized Gainesville area, the Hogtown Creek watershed has undergone extensive urbanization, and now residential and commercial areas around Gainesville account for the majority of land use in the impaired WBID. Land use features in the Kanapaha Lake WBID are tabulated in **Table 19**. These features are based on the National Land Cover Dataset (NLCD) of 1995.

Figure 6. Kanapaha Lake

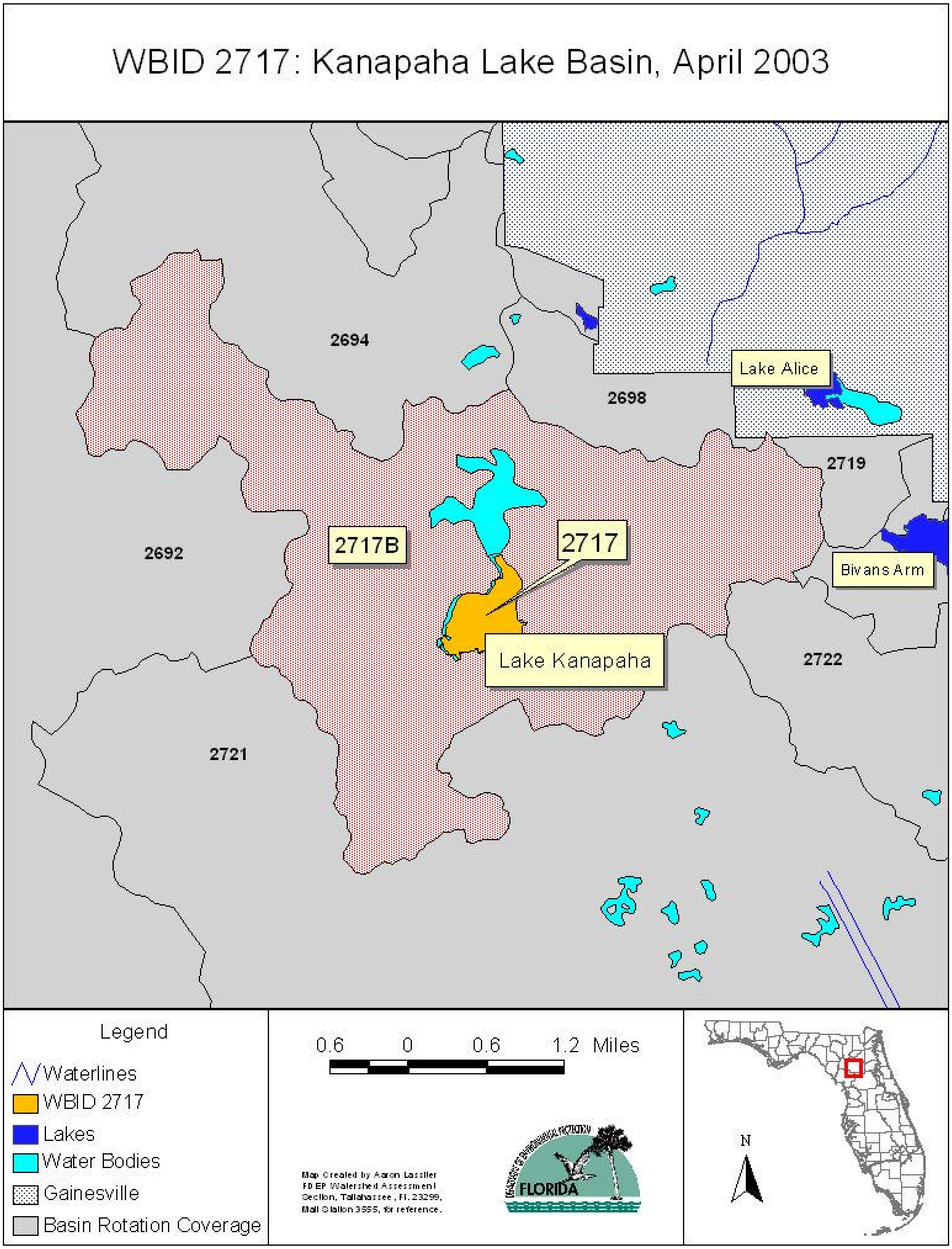


Table 19. Land Use Features in Kanapaha Lake basin (WBID 2717)

Urban		Agriculture		Rangeland		Forest		Water		Wetland		Barren and Extractive		Total
Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres
3356	51	509	7.8	59.4	0.9	2011	30.8	24.5	0.4	511	7.8	64.3	1.0	6535

7.2 Water Quality Standards and Assessment

Kanapaha Lake is classified as Class III waterbody with designated uses of recreation, propagation and maintenance of a healthy, well balanced population of fish and wildlife. The State's Class III water quality criteria applicable to the observed impairment include the un-ionized ammonia criterion (0.02 mg/l), minimum DO of 5.0 mg/l, and the narrative nutrient criterion (i.e., nutrient concentrations of a body of water shall not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna). Because the nutrient criterion is narrative only, nutrient-related targets were needed to represent levels at which imbalance in flora or fauna are not expected to occur.

In recent years Kanapaha Lake has been largely dry, making it difficult to collect relevant water quality samples. Because extensive water quality monitoring data does not exist, it is not possible for EPA to accurately assess the actual nutrient condition of the lake. However, based on the limited data collected and the technical work completed by the Florida Department of Environmental Protection (FDEP) in other lakes in the Gainesville area, EPA is able to propose a TMDL for Kanapaha Lake.

There were two records of chlorophyll measurements in 1990, both very high (i.e., 37.2 and 187.1 ìg/L). On the 303(d) list, FDEP noted that the lake was dominated by macrophytes. To assess nutrient levels in a lake, Trophic State Index (TSI) data is needed, but was not available due to drought conditions. The limited nitrogen and phosphorus water quality monitoring data available for Kanapaha Lake is shown in Table 20.

Table 20. Water Quality Data for Kanapaha Lake (WBID 2717)

Date	Nitrate/Nitrite (mg/L)	Nitrogen Kjeldahl (mg/L)	Total Nitrogen (mg/L)	Phosphorus (mg/L)
4/17/90	0.009	2.5	2.509	0.108
8/27/90	0.008	0.29	0.298	0.03
Average			**1.403**	**0.069**

7.3 TMDL Target

Because of the overall lack of data for Kanapaha Lake, this TMDL is based on the targets in the TMDLs established by FDEP for other lakes (i.e., Lake Wauberg, Newnans Lake, and Orange Lake) in the Orange Creek planning unit. These targets may approximate conditions for Kanapaha Lake that result in no imbalance of natural populations of flora or fauna.

The phosphorus and nitrogen concentrations shown in Table 21 were the result of analysis using a model developed by FDEP for approximating the Trophic State Index appropriate for preventing an imbalance of natural populations of flora and fauna. These concentrations represent an annual average target.

Table 21. Water Quality Observation Stations used in Assessment for WBID 2717.

Lake	Nitrogen (mg/L)	Phosphorus (mg/L)
Lake Wauberg	1.01	0.056
Newnans Lake	0.936	0.060
Orange Lake	Not Calculated	0.028
Average	**0.973**	**0.048**

7.4 Source Assessment

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of nutrients in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or nonpoint sources.

7.4.1 Point Sources

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are typically considered primary sources of nutrients. There are no NPDES permitted facilities that discharge directly to Kanapaha Lake.

One permitted facility, the Kanapaha Wastewater Treatment Plant (FL0112895), currently discharges treated effluent to four disposal wells. Facilities discharging to ground water are regulated by the state permitting program and not through the NPDES program.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge nutrients to waterbodies in response to storm events. EPA developed the federal National Pollutant Discharge Elimination System (NPDES) stormwater permitting program in two phases. Phase I, promulgated in 1990, addresses large and medium municipal separate storm sewer systems (MS4s) located in incorporated places and counties with populations of 100,000 or more; and eleven categories of industrial activities, one of which is large construction activity that disturbs 5 or more acres of land. Phase II, promulgated in 1999, addresses additional sources, including MS4s not regulated under Phase I, and small construction activity disturbing 1 and 5 acres. Phase II began permitting in 2003. Regulated Phase II MS4s are defined in Section 62-624.800, F.A.C. and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 and discharge into either Class I, Class II, or waters designated as Outstanding Florida Waters. Gainesville, including Kanapaha Lake, is included in the Phase II NPDES stormwater permitting program.

In October 2000, EPA authorized FDEP to implement the NPDES stormwater program in all areas of Florida except Indian Country lands. FDEP's authority to administer the NPDES program is set forth in Section 403.0885, Florida Statutes (F.S.). The NPDES stormwater program regulated point source discharges of stormwater into surface waters of the State of Florida from certain municipal, industrial, and construction activities. The NPDES stormwater permitting program is separate from the State's stormwater/environmental resource permitting program, and local stormwater/water quality programs, which have their own regulations and permitting requirements.

7.4.2 Nonpoint Sources

Nonpoint sources of nutrients are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location, such as runoff from urban land uses, runoff from agriculture and silviculture, runoff from mining, discharges from failing septic systems, and atmospheric deposition. These sources generally, but not always, involve the accumulation of nutrients on land surfaces and wash off as a result of storm events.

7.5 Development of Total Maximum Daily Loads

A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), nonpoint source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. Federal regulations [40 CFR §130.2 (i)] state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The Total Phosphorus (TP) and Total Nitrogen (TN) TMDL for Kanapaha Lake is expressed in terms of concentration (milligrams per liter) and represents the average annual concentration of load the lake can assimilate and maintain the narrative nutrient criterion. This is the most appropriate measure for this TMDL due to the fact that water loading into the lake is intermittent and water levels in the lake are not consistent. A total mass load to the lake would not be appropriate considering the unpredictability of flow to the lake. More appropriately, EPA is proposing a concentration to be applied to the flow to the lake when it occurs, regardless of volume. The percent reduction needed to achieve this average annual concentration was also calculated. The TMDL components are shown in Table 22 and represent the amount of phosphorus and nitrogen needed to reduce the average concentration represented by the two samples taken in 1990 to the TMDL concentration.

Table 22. Total Phosphorus and Total Nitrogen TMDL for Kanapaha Lake (WBID 2717)

Parameter	WLA		LA (mg/L)	MOS	TMDL (mg/L)	Percent Reduction
	NPDES Wastewater Discharge	NPDES Stormwater (% Reduction)				
Phosphorus	N/A	30.4	0.048	Implicit	0.048	**30.4***
Nitrogen	N/A	30.6	0.973	Implicit	0.973	**30.6****

*** (0.069 mg/L - 0.048 mg/L)/0.069 mg/L**
**** (1.403 mg/L - 0.973 mg/L)/1.403 mg/L**

7.5.3 Wasteload Allocations (WLAs)

WLAs for stormwater discharges are typically expressed as "percent reduction" because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges is also different from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities. Instead, stormwater discharges are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of best management practices (BMPs).

EPA guidance specifies that MS4 permits fall under the WLA and are allocated a percent reduction of the load. Since Kanapaha Lake is in the Gainesville MS4 area, it is being assigned a wasteload allocation based on the percent reduction from current loads.

Although the aggregate wasteload allocation for storm water discharges is expressed as a percent reduction, based on the information available today, it is infeasible to calculate numeric WLAs for individual storm water outfalls because discharges from these sources can be highly intermittent, are usually characterized by very high flows occurring over relatively short time intervals, and carry a variety of pollutants whose nature and extent varies according to geography and local land use. For example, municipal sources such as those covered by this TMDL often include numerous individual outfalls spread over large areas. Water quality impacts, in turn, also depend on a wide range of factors, including the magnitude and duration of rainfall events, the time period between events, soil conditions, fraction of land that is impervious to rainfall, other land use activities, and the ratio of storm water discharge to receiving water flow. This TMDL assumes for the reasons stated above that it will be infeasible to calculate numeric water quality-based effluent limitations for total phosphorus for storm water discharges. Therefore, in the absence of information presented to the permitting authority showing otherwise, this TMDL assumes that water quality-based effluent limitations for storm water sources of total phosphorus derived from this TMDL can be expressed in narrative form (e.g., as best management practices), provided that: (1) the permitting authority explains, in the permit fact sheet, the reasons it expects the chosen BMPs to achieve the aggregate wasteload allocation for these storm water discharges; and (2) the State will perform ambient water quality monitoring for total phosphorus for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

7.5.4 Load Allocations (LAs)

The allowable LAs are 0.048 mg/L for TP and 0.973 mg/L for TN. These values correspond to reductions from the existing loadings of about 30 percent for both parameters. It should be noted that the LA includes loading from stormwater discharges that are not regulated by the NPDES stormwater permitting program.

7.5.5 Margin of Safety (MOS)

There are two options for incorporating a MOS in a TMDL: (a) implicitly by using conservative model assumptions to develop allocations; or (b) explicitly by specifying a portion of the TMDL as the MOS and using the remainder for allocations. An implicit MOS is incorporated in this TMDL because the target was derived from TMDLs developed for nearby lakes that incorporated implicit margins of safety.

7.6 Critical Conditions

Critical conditions were considered in the modeling approaches used to derive the nutrient concentration targets for the nearby lake TMDLs. Those TMDLs were used to determine the target for this TMDL.

7.7 Seasonal Variation

Season variation was incorporated in the modeling approaches used to derive the nutrient concentration targets for the nearby lake TMDLs, and those TMDLs were used to determine the target for this TMDL. The targets in those TMDLs were also applied as an average annual concentration to account for seasonal fluctuations.

REFERENCES

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APPENDIX A WATER QUALITY DATA

List of Tables

List of Figures

Table A- 1. Guide to Water Quality Remark Codes (Rcode column in data tables)

Remark Code	Definition	Use in TMDL
A	Value reported is mean of two or more samples	Data included in analysis as reported
B	Result based on colony counts outside the acceptable range	Data not included in analysis as reported
E	Extra sample taken in compositing process	Data included as average
I	The value reported is less than the practical quantification limit and greater than or equal to the method detection limit.	Data included in analysis as reported
K	Off-scale low. Actual value not known, but known to be less than value shown	Data included in analysis as reported
L	Off-scale high. Actual value not known, but known to be greater than value shown	Data included in analysis as reported
Q	Sample held beyond normal holding time	Data not used in analysis
T	Value reported is less than the criteria of detection	Data included in analysis if the reported value is below criteria; otherwise, reported value is not used in the analysis
U	Material was analyzed for but not detected. Value stored is the limit of detection.	Data not included in analysis
<	NAWQA – actual value is known to be less than the value shown	Data included in analysis

Table A- 2. Fecal Coliform Data Collected in Hatchet Creek (WBID 2688)

WBID	Station	Date	Rcode	Result
2688	21FLA 20020122	8/28/96	Q	66
2688	21FLA 20020122	3/24/97		120
2688	21FLCEN 20020122	2/11/02	Q	42
2688	21FLGW 7462	6/28/00		42
2688	21FLSJWM02240800	9/10/97	U	2
2688	21FLSJWM02240800	4/10/96	Q	20
2688	21FLSJWM02240800	10/1/97		38
2688	21FLSJWM02240800	6/3/98		66
2688	21FLSJWM02240800	11/24/97		72
2688	21FLSJWM02240800	8/6/96	Q	80
2688	21FLSJWM02240800	4/8/98		88
2688	21FLSJWM02240800	7/30/97		104
2688	21FLSJWM02240800	8/12/97		104
2688	21FLSJWM02240800	1/7/98		130
2688	21FLSJWM02240800	6/16/97		170
2688	21FLSJWM02240800	2/12/96		230
2688	21FLSJWM02240800	6/11/96		300
2688	21FLSJWM02240800	6/6/95	Q	320
2688	21FLSJWM02240800	8/28/95	Q	500
2688	21FLA 20020122	8/28/96	Q	500
2688	21FLA 20020122	3/24/97	Q	500
2688	21FLCEN 20020122	2/11/02	Q	500
2688	21FLGW 7462	6/28/00		600
2688	21FLSJWM02240800	9/10/97	Q	2400
2688	21FLSJWM02240800	4/10/96	Q	2400
2688	21FLSJWM02240800	10/1/97	Q	3000
2688	21FLSJWM02240800	6/3/98	<	3
2688	21FLSJWM02240800	11/24/97		13
2688	21FLSJWM02240800	8/6/96		103
2688	21FLSJWMHAT26	7/26/93		4800
2688	Hat26	7/10/02		130
2688	Hat26	8/14/02		50
2688	Hat26	9/11/02		50
2688	Hat26	10/15/02		79
2688	Hat26	11/6/02		94
2688	Hat26	11/6/02		130
2688	Hat26	12/11/02		240
2688	Hat26	1/15/03		240
2688	Hat26	2/12/03		170
2688	Hat26	3/13/03		49

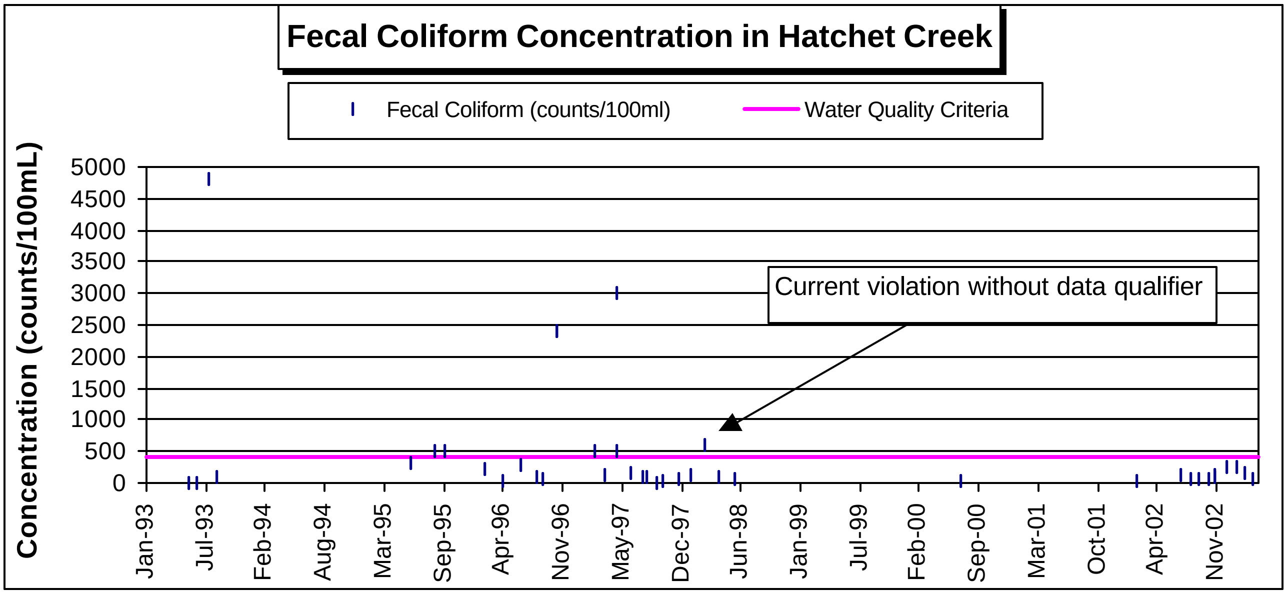

Figure A- 1. Fecal Coliform Meausements in Hatchet Creek (WBID 2688)

Table A- 3. Total Coliform Measurements in Hogtown Creek (WBID 2698)

wbid	BASIN	sta	Date	time	rcode	result cnts/100mL	Parameter
2698	HOGTOWN CREEK	21FLACEPHOG22	2/7/02	1030		2400	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOG30	2/7/02	1100		1100	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOG30	2/7/02	1055		50000	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOGNW45	2/7/02	1000		3000	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOGSINK	2/7/02	1105		5000	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOGSW2	2/7/02	1040		2400	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOGTOWN CR 4	8/10/94	1250		300	TCOLI
2698	HOGTOWN CREEK	21FLACEPHOGTOWN CR 4	7/18/95	1105	L	1600	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020072	2/11/02	1116		718	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020072	5/22/02	1103		3100	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020072	11/6/01	1404		3300	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020072	2/18/02	1216		5600	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020115	2/18/02	1141		1475	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020115	5/22/02	1205		1750	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020115	11/6/01	1314		2100	TCOLI
2698	HOGTOWN CREEK	21FLCEN 20020115	2/11/02	1051		2900	TCOLI
2698	HOGTOWN CREEK	21FLGW 7451	6/26/00	1455		5600	TCOLI
2698	HOGTOWN CREEK	21FLGW 7463	6/7/00	1315		3500	TCOLI
2698	HOGTOWN CREEK	21FLGW 7480	6/27/00	1115		4600	TCOLI

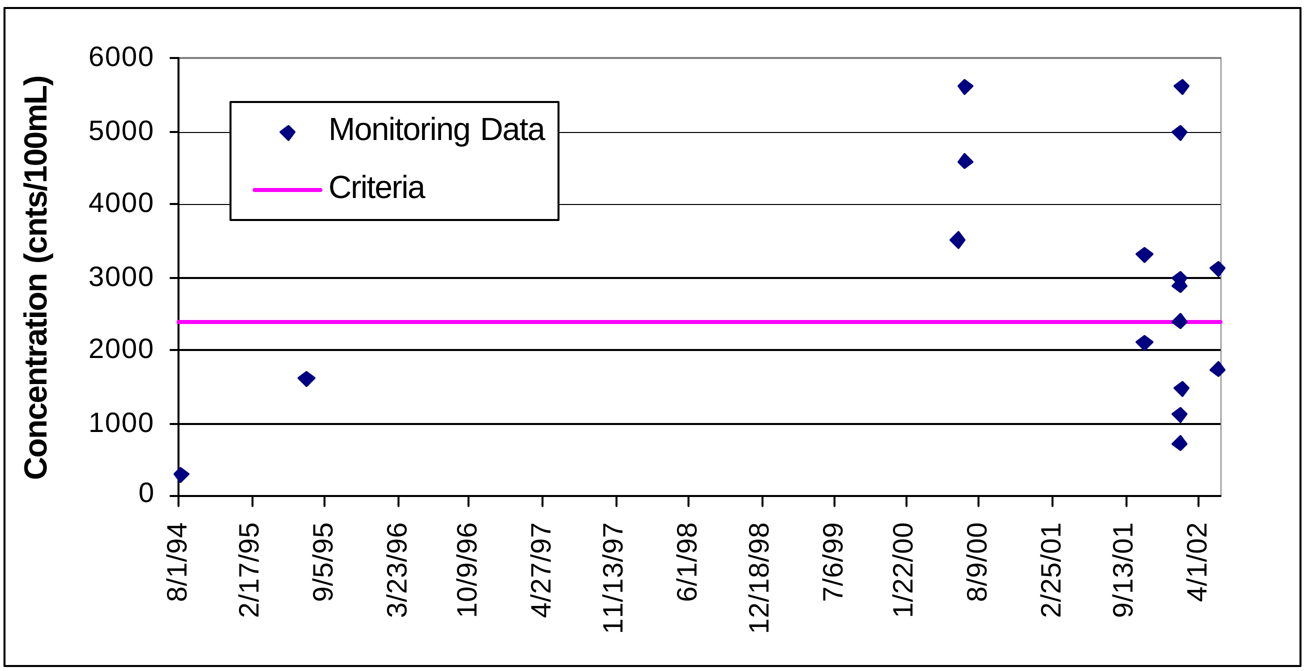

Figure A- 2. Total coliform data collected at all stations in Hogtown Creek (note: Sample collected on 2/7/02 of 50,000 counts/100mL not included on plot due to scale)

Table A- 4. Total Coliform Data Collected in Sweetwater Branch (WBID 2711)

WBID	BASIN	Station	Date	time	rcode	result cnts/100mL	Parameter
2711	SWEETWATER BRANCH	21FLACEPSWB15	8/16/00	950		130	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWB331	3/8/01	1045		3000	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWBSE4	5/7/01	900		8000	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR3	6/7/90	1025	L	1600	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR4A	2/10/92	1105		500	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR4A	1/26/94	1115		130	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR4A	8/11/94	1115		130	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR3	8/11/94	1150	L	1600	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR3	7/20/95	1200		2200	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR4A	8/11/94	1200		2200	TCOLI
2711	SWEETWATER BRANCH	21FLACEPSWEETWATER BR4A	7/20/95	1530		4600	TCOLI
2711	SWEETWATER BRANCH	21FLGW 9327	8/10/00	1045		795	TCOLI
2711	SWEETWATER BRANCH	SWB 331	3/12/03			1700	TCOLI
2711	SWEETWATER BRANCH	SWB SE1	3/12/03			4900	TCOLI
2711	SWEETWATER BRANCH	SWB NE10	3/12/03			17000	TCOLI

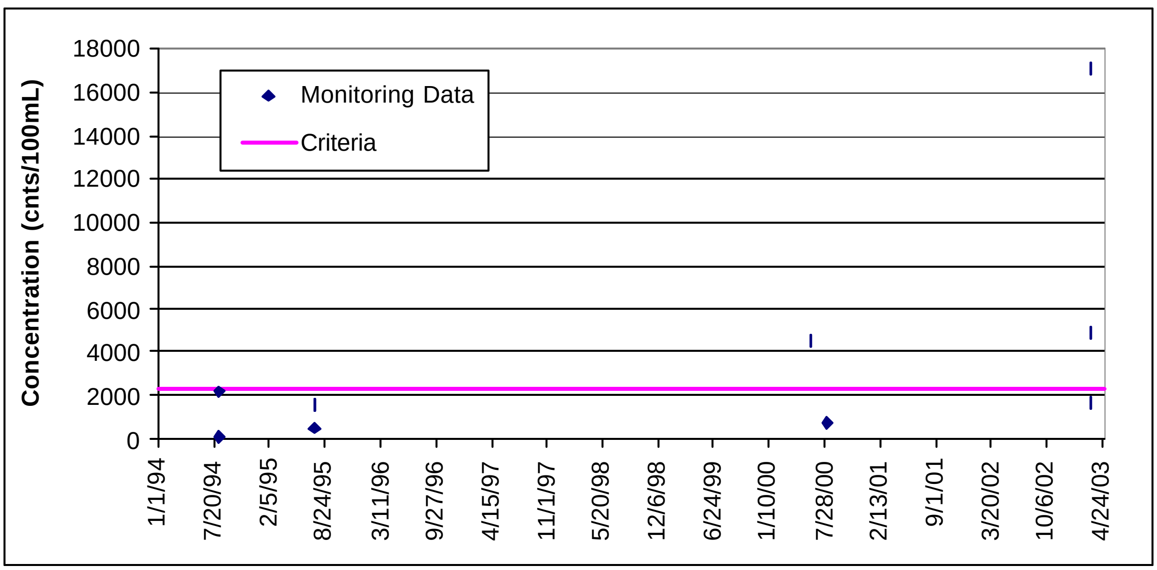

Figure A- 3. Total coliform data collected in at all stations in Sweetwater Branch

Table A- 5. Total Coliform Data Collected in Ocklawaha River/Sunnyhill (WBID 2740F)

WBID	BASIN	Station	Date	Time	Rcode	Result cnts/100mL	Parameter
2740F	OCKLAWAHA R/SUNNYHILL	21FLA 20020306	1/24/95	1240	A	200	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLA 20020306	7/12/94	1130	B	1000	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020306	4/9/02	1359		260	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020306	12/18/01	1402		1280	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020306	3/5/02	1312		3800	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020306	1/23/02	1353		7800	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020355	4/9/02	1346		195	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020355	12/18/01	1345		235	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020355	1/23/02	1333		7200	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLCEN 20020355	3/5/02	1232		7800	TCOLI
2740F	OCKLAWAHA R/SUNNYHILL	21FLGW 8734	8/21/00	1045		450	TCOLI

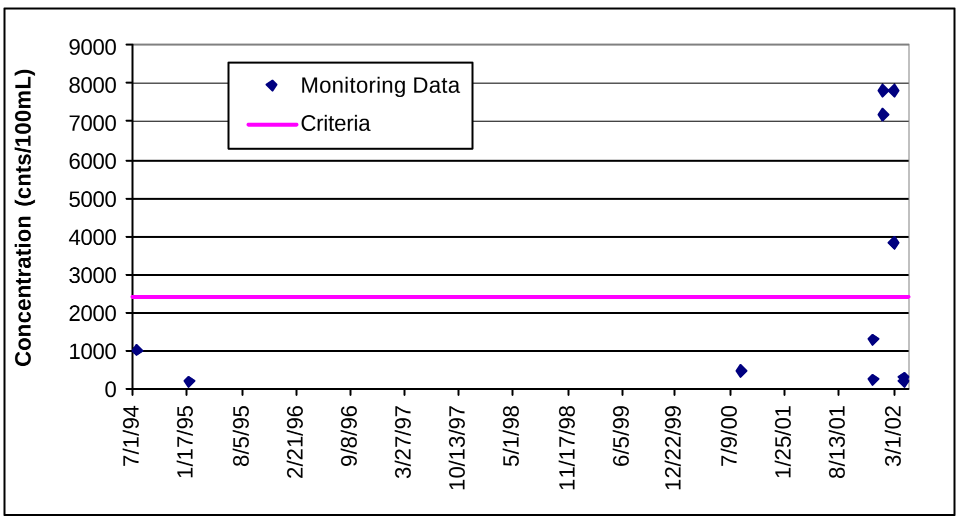

Figure A- 4. Total coliform data collected at all stations in Ocklawaha River/Sunnyhill

Table A- 6. Fecal Coliform Data Collected in Haines Creek Reach (WBID 2817A)

WBID	BASIN	Station	Date	Time	Rcode	Result cnts/100mL	Parameter
2817A	HAYNES CREEK REACH	21FLLCPCORC6	8/8/00	1035		36	FCOLI
2817A	HAYNES CREEK REACH	21FLLCPCORC6	3/12/02	1125		92	FCOLI
2817A	HAYNES CREEK REACH	21FLLCPCORC6	2/8/00	1050		98	FCOLI
2817A	HAYNES CREEK REACH	21FLLCPCORC6	11/1/00	1055		136	FCOLI

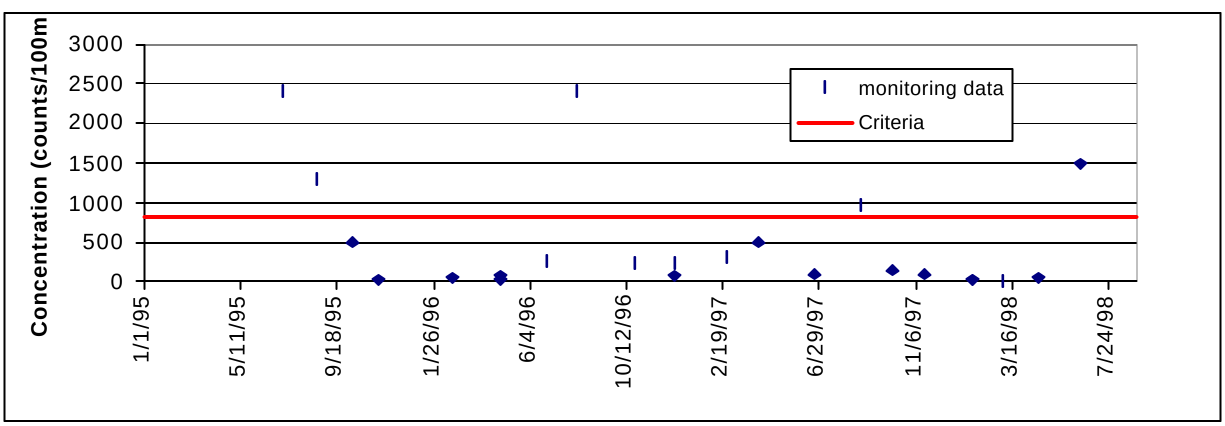

Figure A- 5. Fecal coliform data collected at all stations in Haines Creek Reach

Table A- 7. Total Coliform Data Collected in Haines Creek Reach (WBID 2817A)

WBID	BASIN	Station	Date	Time	Rcode	Result cnts/100mL	Parameter
2817A	HAYNES CREEK REACH	21FLLCPCORC6	5/14/01	1130		900	TCOLI
2817A	HAYNES CREEK REACH	21FLLCPCORC6	3/12/02	1125		209	TCOLI
2817A	HAYNES CREEK REACH	21FLLCPCORC6	8/13/01	1115		3300	TCOLI

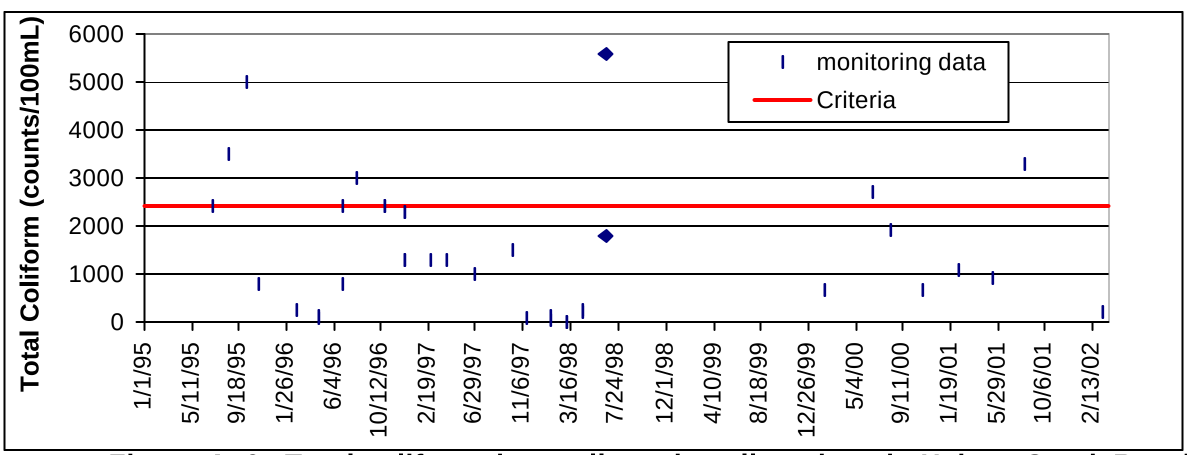

Figure A- 6. Total coliform data collected at all stations in Haines Creek Reach

Table A- 8. Fecal Coliform Data Collected in Daisy Creek (WBID 2769)

Station Location	Station No.	Date	Rcode	Result (#/100mL)
Daisy Creek @ NE 105th Street	20020146	07/17/02	B	4666
Daisy Creek @ NE 105th Street	20020146	09/23/02	A B	95
Daisy Creek @ NE 105th Street	20020146	06/23/03		1913
Daisy Creek @ SR 315	20020118	07/17/02	A	90
Daisy Creek @ SR 315	20020118	09/23/02	B	880
Daisy Creek @ SR 315	20020118	06/23/03		800
Unnamed tributary @ SR 315 approximately 1.3 miles North of Daisy Creek	20020026	07/17/02		88
Unnamed Tributary @ SR 315 approximately 1.3 miles north of Daisy Creek	20020026	09/23/02		73
Unnamed Tributary @ SR 315 approximately 1.3 miles north of Daisy Creek	20020026	06/23/03		2000
Unnamed Tributary @ SR 315 just south of Daisy Creek	20020025	09/23/02	B	67
Unnamed tributary @ SR 315 just South of Daisy Creek.	20020025	07/17/02		190
Unnamed tributary @ SR 315 just South of Daisy Creek.	20020025	06/23/03		2600

means the value is outside the acceptable range; rcode "A" means the value is the mean of two samples

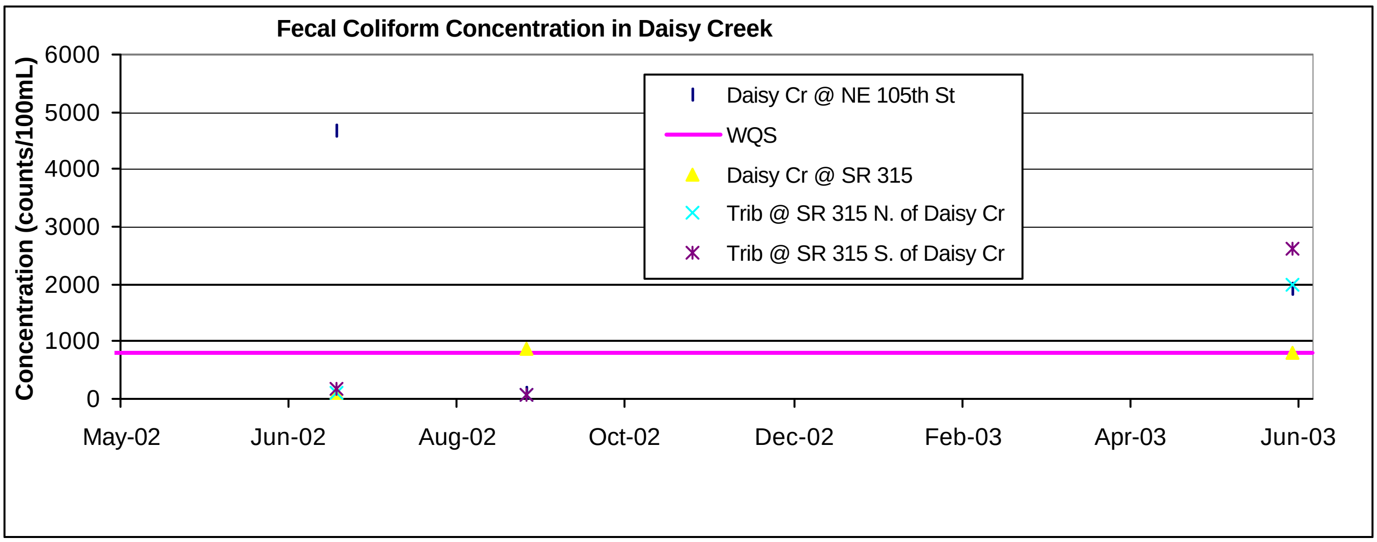

Figure A- 7. Fecal Coliform Data Collected in Daisy Creek (WBID 2769)

Table A- 9. Fecal Coliform Data Collected in Ocklawaha River above Daisy (WBID 2740D)

wbid	BASIN	sta	Date	time	rcode	result
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	6/5/1990	958	<	
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	1/28/1991	1100		2
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	11/16/1989	942		3
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	1/23/1990	836		3
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	12/17/1991	722		4
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	3/13/1990	1008		4
2740D	OCKLAWAHA RIV AB DAISY	112WRD 02240000	4/14/1992	1222		4

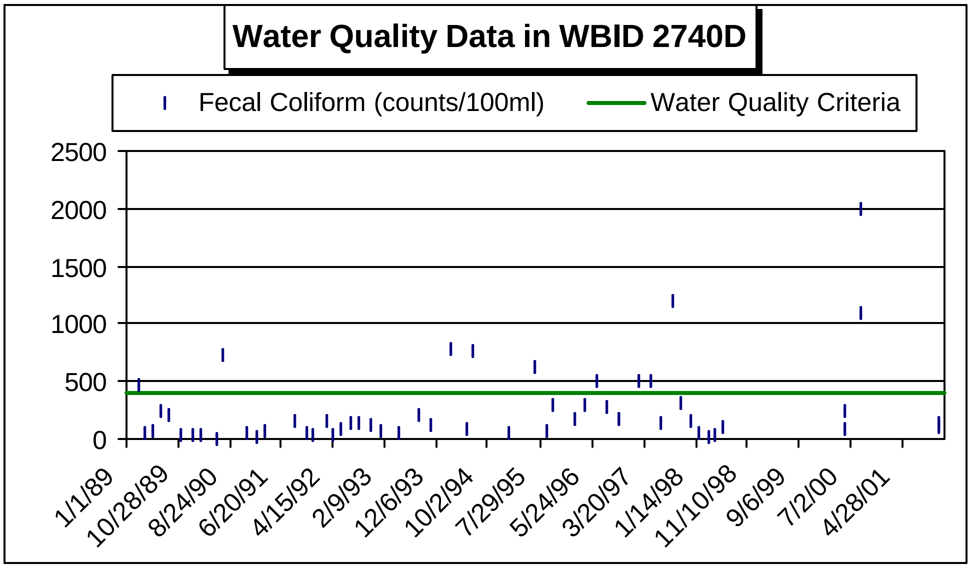

Figure A- 8. Fecal Coliform Measurements in WBID 2740D

Table A- 10. Selenium Measurements in WBID 2838A

WBID	BASIN	Station	Date	Time	Rcode	Result (ug/L)	Parameter
2838A	LAKE HARRIS	21FLSJWM HAR	1/20/99	1130	T	0.23	SE
2838A	LAKE HARRIS	21FLSJWM HAR	3/18/99	1100	T	0.31	SE
2838A	LAKE HARRIS	21FLSJWM HAR	5/18/99	1100	W	0.001	SE

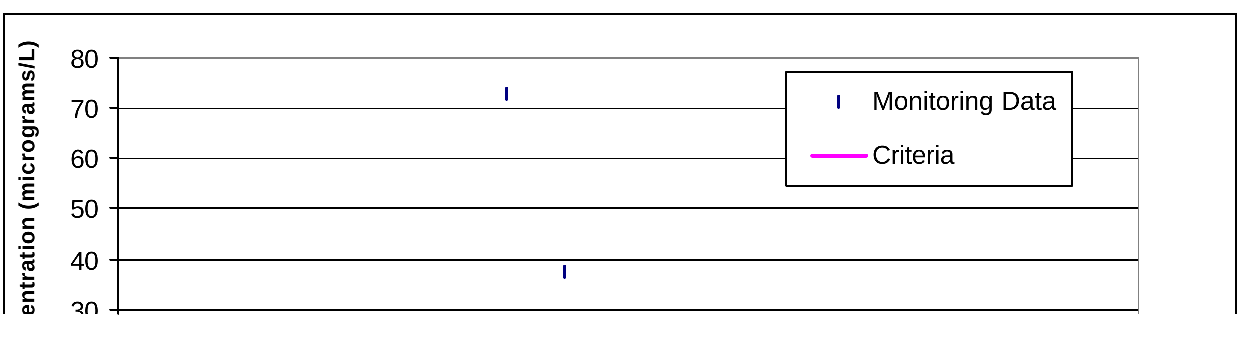
entration (micrograms/L)
80
70
60
50
40
30
Monitoring Data
Criteria

Figure A- 9. Selenium Concentration in Lake Harris (includes all data regardless of remark code)

Table A- 11. Silver Data Collected in Lake Dora (WBID 2831B)

WBID	BASIN	Station	Date	Time	rcode	result (ug/L)	Parameter
2831B	LAKE DORA	21FLSJWMDOR	11/30/93	1650	u	0.1	AG
2831B	LAKE DORA	21FLSJWMDOR	3/24/94	1525	u	0.1	AG
2831B	LAKE DORA	21FLSJWMDOR	9/21/94	1420	u	0.1	AG
2831B	LAKE DORA	21FLSJWMDOR	11/9/94	1351	u	0.1	AG
2831B	LAKE DORA	21FLSJWMDOR	11/9/94	1350	u	0.1	AG
2831B	LAKE DORA	21FLSJWMDOR	1/6/94	1250		0.2	AG
2831B	LAKE DORA	21FLSJWMDOR	1/6/94	1251		0.8	AG
			1/6/94		ave	0.5	AG
2831B	LAKE DORA	21FLSJWMDOR	5/26/94	1525		0.1	AG
2831B	LAKE DORA	21FLSJWMDOR	7/18/94	1530		0.3	AG
2831B	LAKE DORA	21FLSJWMDOR	1/5/95	1245		0.21	AG
2831B	LAKE DORA	21FLSJWMDOR	3/6/95	1345		0.01	AG

Appendix B CALCULATION OF COLIFORM TMDLS

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<u>Constructing Flow Duration Curves</u>

One of the shortcomings of using flow and load duration curves for data analysis is the method requires a significant amount of flow data. If continuous flow gages are not located in a WBID or if the locations of the water quality monitoring station and flow gage are not the same, techniques must be used to estimate flows. Sweetwater Branch is located in a karst area and simple techniques for estimating flow are not applicable; therefore, without flow records, it is not possible to calculate loads. The monitoring station on Haines Creek Reach is located at a gaging station. Flow at the time of sampling was assumed to approximate flow measured at the gage on the same day.

The common approach for estimating flow at a monitoring station that is at a different location than the gage, is to multiply the flow at the gaged site by the drainage area ratio between the two sites. This approach is valid when the drainage area ratio of the ungaged site to the gaged site is within about 0.5 to 1.5. Flows at the monitoring stations on Ocklawaha River/Sunnyhill and Hatchet Creek were estimated using this approach and measured flows at the gage on Ocklawaha River at Moss Bluff, FL (USGS 02238500) and Hogtown Creek, respectively.

Alachua County conducted a baseflow study on Hogtown Creek where flows were measured monthly at the water quality monitoring station from 1998 through 2002. Water quality samples were collected with some of the flow measurements. A method was needed to estimate flows at times for which water quality data were available but flow was not. To utilize the available data, flows measured at the monitoring station were plotted against flows measured at the USGS gage, located downstream of the monitoring station, to identify a correlation between the datasets. As shown in Figure B-1, a strong correlation exists between the datasets. A trend line equation was drawn through the data points and used to develop a continuous flow record at the monitoring station. To check the accuracy of the estimated flows, the flows estimated using the trendline equation were compared to flows estimated using a weighted drainage area approach and the measured flows. As shown in Figure B-2, the trend line equation appears to be a better predictor of flows on Hogtown Creek than the weighted drainage area approach.

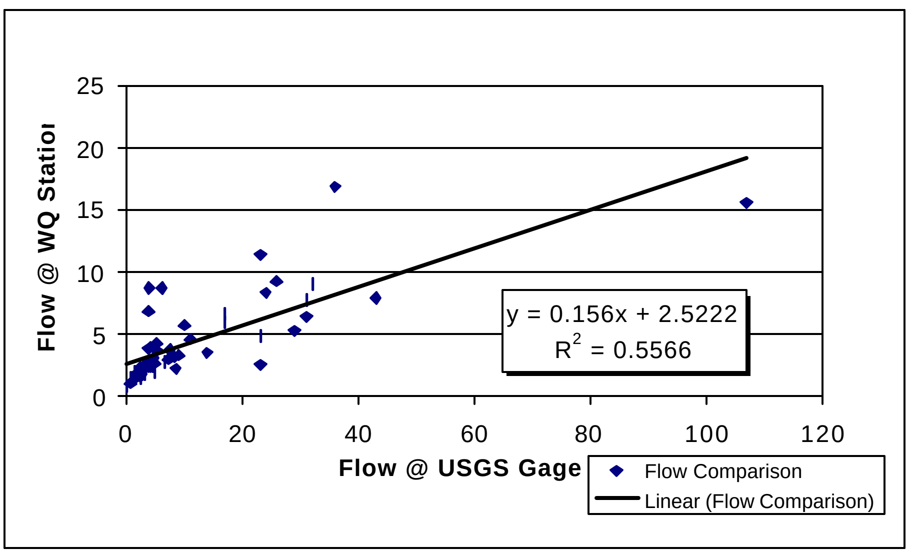

Figure B- 1. Correlation Between Flow Measured at Sta. HOGNW22 and USGS 02240954

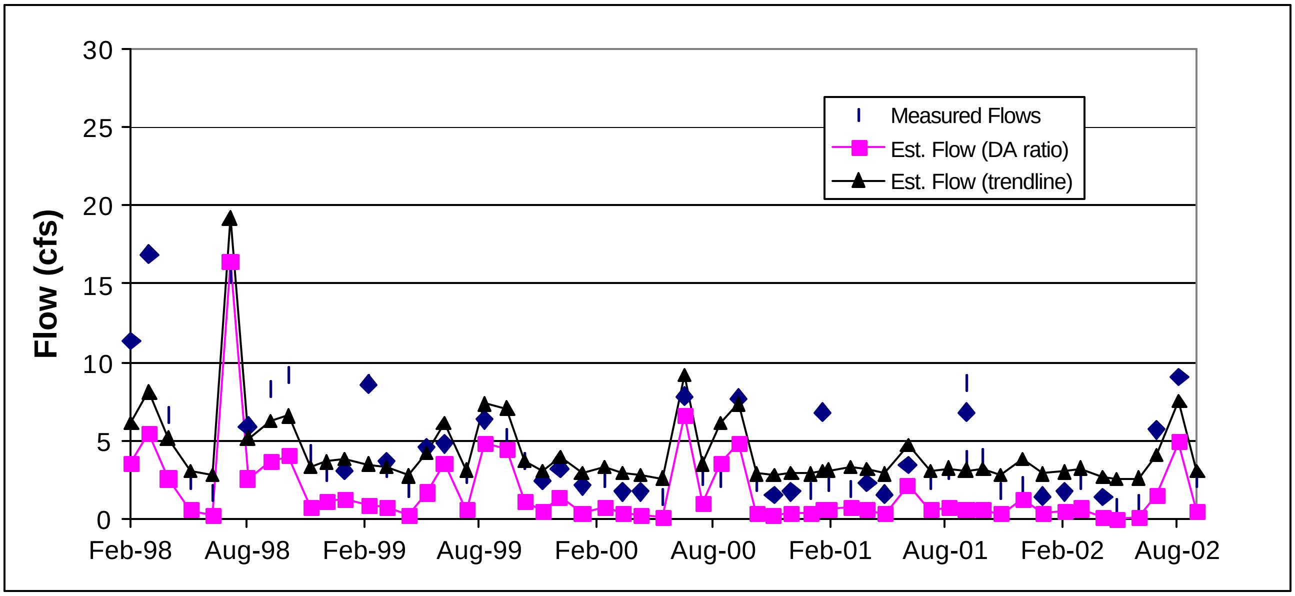

Figure B- 2. Comparison of Flow Estimation Techniques for Hogtown Creek

A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The confidence in the duration curve approach in predicting realistic percent load reductions increases when longer periods of record are used to generate the curves. The flow duration curve is easily generated in a spreadsheet, such as Excel, by using the percentile function and the flow record to generate the flow at a given duration interval. For example, at the 90th duration interval, the percentile function calculates the flow that is equal or exceeded 90 percent of the time. The flow duration curve for Hogtown Creek generated from the estimated flow record at the water quality sampling station is shown in Figure B-3. Flows toward the right side of the plot are flows exceeded in greater frequency and are indicative of low flow conditions. Flows on the left side of the plot represent high flows and occur less frequently.

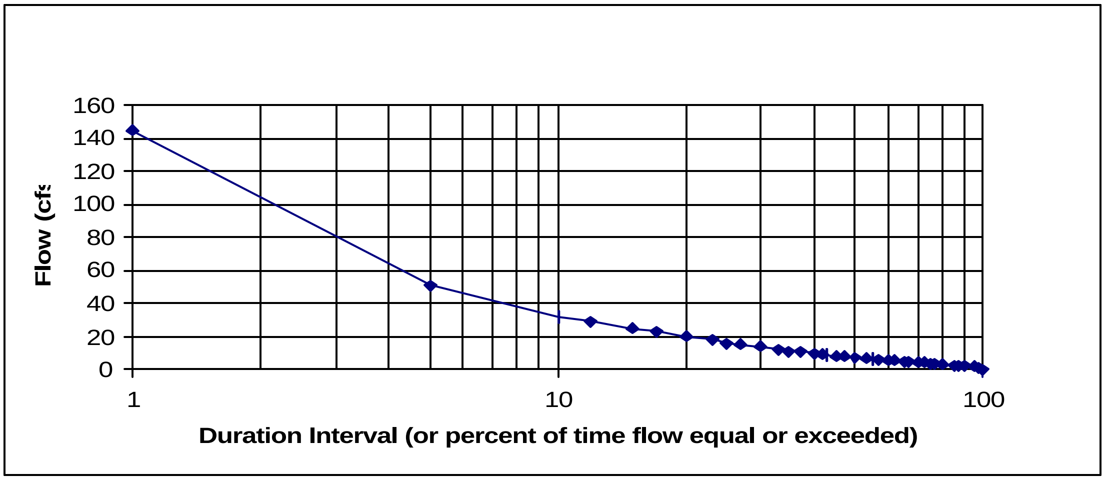

Figure B- 3. Flow Duration Curve for Hogtown Creek at Station HOGNW22

Constructing Load Duration Curves

The load duration curve is a visual display of the existing and allowable loads at each interval on the flow duration curve. The existing loads are based on the instream coliform concentrations measured during ambient monitoring and an estimate of flow at the station. Allowable loads, or TMDL, are based on the flow values at each interval on the flow duration curve and the applicable water quality criterion. Because insufficient data were collected to evaluate either the geometric mean or not to exceed percentage criteria, the one-day maximum criterion for coliforms is the target criterion in these TMDLS.

The water quality samples collected at a monitoring station are separated into two groups depending on whether they violate the numerical target. Using Equation 2 (see Section 5.3.1), loads are calculated for each sample using the flow estimated or measured on the sampling day. Loads are expressed in units of counts per day to reflect the instantaneous criterion. The two groups of loads are plotted on the load duration curve with unique symbols. The positioning of the loads on the curve is based on the duration interval of the stream flow. Loads positioned above the allowable load line represent violations of the criterion while loads positioned below the line represent compliance with the criterion. The load duration curve for total coliform in Hogtown Creek is shown in Figure B-4.

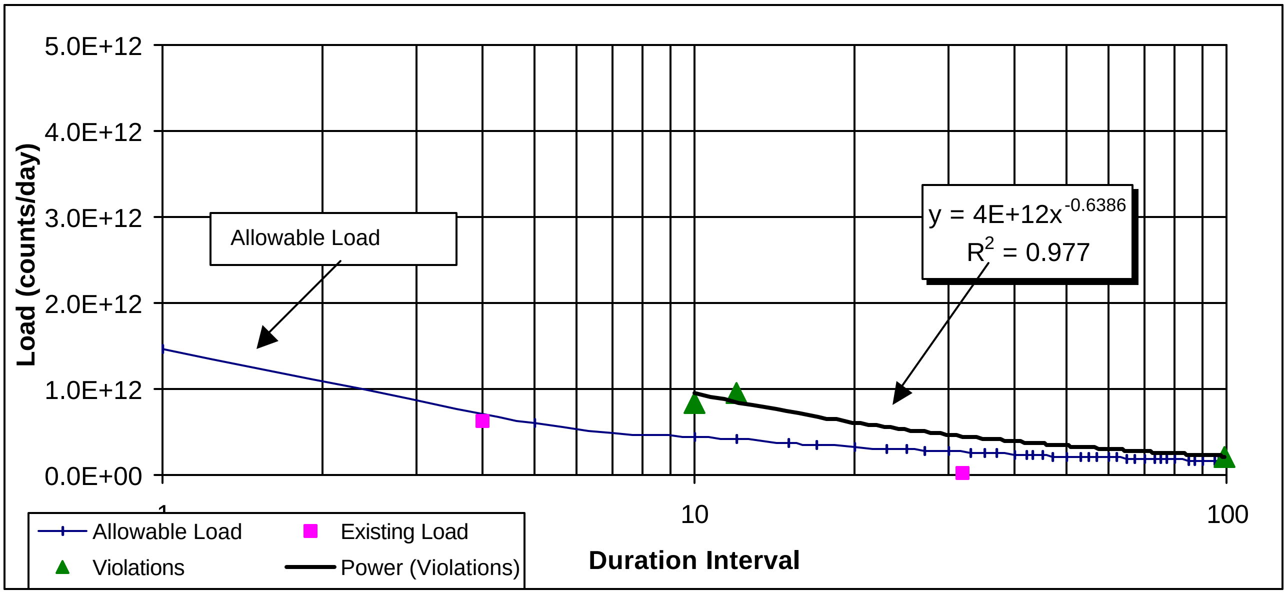

Figure B- 4. Load Duration Curve for Total Coliform In Hogtown Creek

As shown in Figure B-4, a trend line is drawn through the loads representing violations of the criterion. The equation of this line is used to estimate violations over the range of intervals on the duration curve. If fewer than two samples collected on an impaired stream violated the target, a trend line was not drawn. The type of trend line used (i.e., linear, logarithmic, polynomial, etc.), reflected the best visual fit of the data and had the highest correlation coefficient (R^2 value). In the trend line equation, the x-variable is the duration interval.

The load calculated using the trend line equation is called the existing load. At each duration interval, if the existing load is greater than the target load, a percent reduction is required to meet the water quality criterion. The TMDL and percent reductions are calculated as the average of all the loads and percent reductions calculated at the various recurrence intervals where a violation occurred. The WLA component, if applicable, is assumed constant and is based on the facility design flow and one-day maximum concentration limit. The LA component is obtained by subtracting the WLA from the TMDL. The MOS is implicit and not assigned a value in the TMDL equation. Calculation of the TMDL and percent reduction for total coliform in Hogtown Creek is shown in Table B-1.

Table B- 1. TMDL and Percent Reduction for Total Coliform in Hogtown Creek

Inteval	Allowable Load (counts/day)	Existing Load (counts/day)	Percent Reduction
99	1.51E+11	2.13E+11	29.0
95	1.63E+11	2.18E+11	25.2
90	1.69E+11	2.26E+11	25.3
85	1.74E+11	2.34E+11	25.7
80	1.79E+11	2.44E+11	26.6
75	1.83E+11	2.54E+11	27.8
70	1.89E+11	2.65E+11	28.8
65	1.94E+11	2.78E+11	30.1
60	2.01E+11	2.93E+11	31.4
55	2.07E+11	3.10E+11	33.1
50	2.14E+11	3.29E+11	34.8
45	2.24E+11	3.52E+11	36.2
40	2.37E+11	3.79E+11	37.4
35	2.48E+11	4.13E+11	39.9
30	2.76E+11	4.56E+11	39.5
25	2.94E+11	5.12E+11	42.6
20	3.30E+11	5.91E+11	44.0
15	3.76E+11	7.10E+11	47.0
10	4.40E+11	9.19E+11	52.1
5	6.14E+11	1.43E+12	57.1
1	1.47E+12	4.00E+12	63.3

Average Values Between the 10th and 90th duration interval

Allowable Load (counts/day):	2.43E+11
Existing Load (counts/day):	3.98E+11
Percent Reduction (%):	35.4

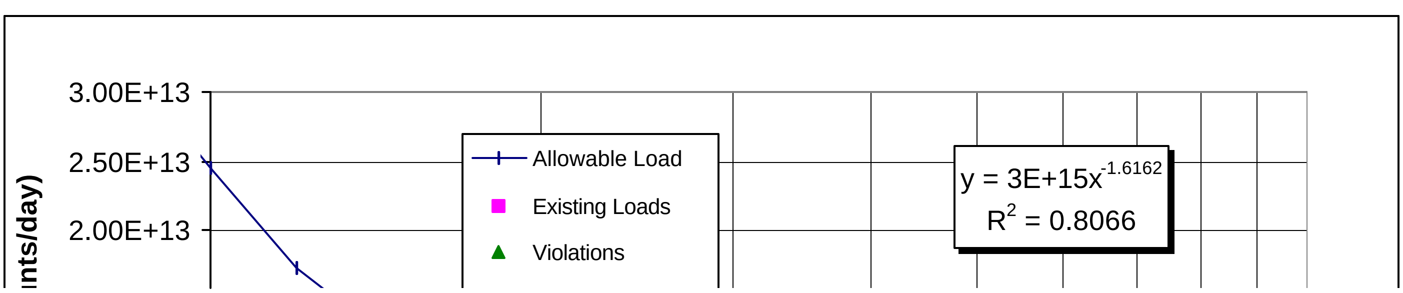

Figure B- 5. Load Duration Curve for Total Coliform in Haines Creek Reach (WBID 2817)

Table B- 2. Calculation of Total Coliform TMDL for Haines Creek Reach (WBID 2817)

TMDL and existing loads represent average between the 90th and 10th interval
TMDL load based on one day maximum concentration of 2400 counts/100ml

TMDL load (cnts/day)	4.90E+12
Existing load (cnts/day)	1.28E+13
% Reduction	48.2

Trendline Equation (power): y = 3E+15x-1.6162
R2 = 0.8066

Interval	Allowable Load (cnts/day)	Exist. Load (cnts/day)	Reduction (percent)
99	3.46E+11	1.79E+12	80.6
95	8.79E+11	1.91E+12	54.0
90	1.34E+12	2.08E+12	35.9
85	1.52E+12	2.28E+12	33.3
80	1.64E+12	2.52E+12	34.9
75	1.70E+12	2.80E+12	39.3
70	1.82E+12	3.13E+12	41.9
65	2.05E+12	3.52E+12	41.8
60	2.34E+12	4.01E+12	41.6
55	2.69E+12	4.62E+12	41.6
50	2.99E+12	5.39E+12	44.5
45	3.34E+12	6.39E+12	47.7
40	3.81E+12	7.72E+12	50.7
35	4.45E+12	9.59E+12	53.6
30	5.04E+12	1.23E+13	59.0
25	5.74E+12	1.65E+13	65.2
20	7.09E+12	2.37E+13	70.1
15	1.12E+13	3.77E+13	70.2
10	2.44E+13	7.26E+13	66.3
5	5.39E+13	2.23E+14	75.8
1	8.43E+13	3.00E+15	97.2

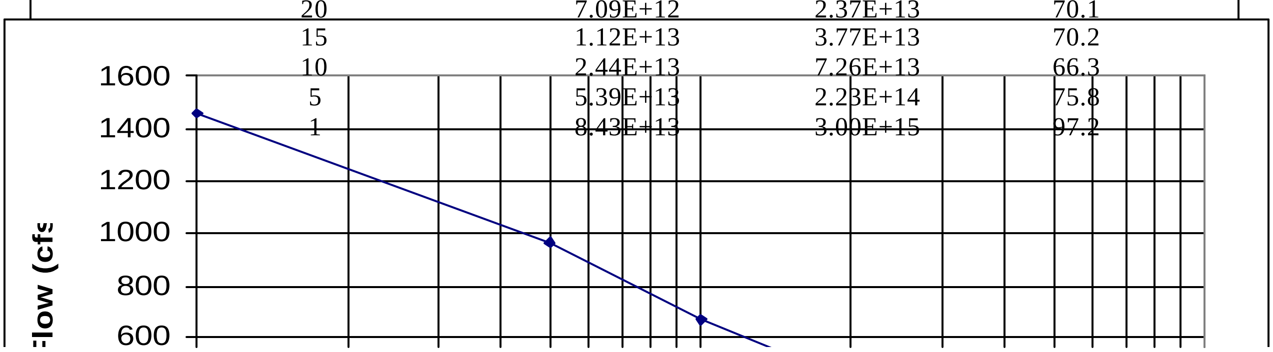

Figure B- 6. Flow Duration Curve for Ocklawaha River at Moss Bluff, FL (USGS 02238500)

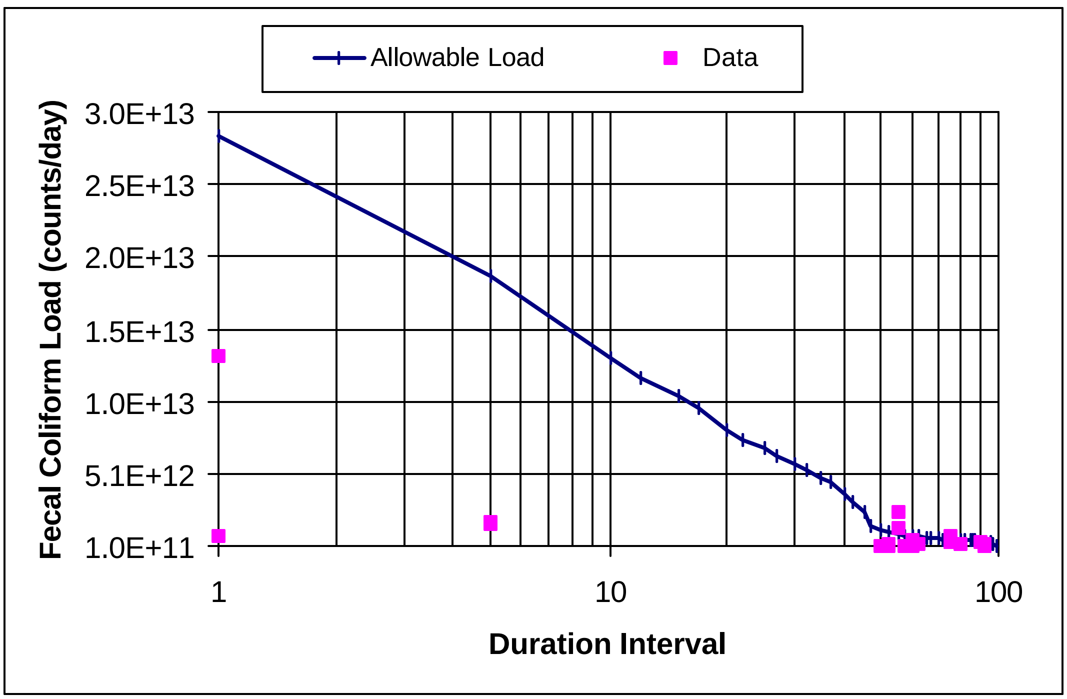

Figure B- 7. Fecal Coliform Load Duration Curve in Ocklawaha River above Daisy (WBID 2740D)

Table B- 3. Calculation of Fecal Coliform TMDL and Percent Reduction for Ocklawaha River above Daisy (WBID 2740D)

TMDL and percent reduction based on available data and 50th percentile of flow (using 800 criteria)

Station	Existing Load (counts/day)	Allowable Load (counts/day)	Reduction (%)
21FLSJWM20020001	7.91E+11	5.27E+11	33.3

Check on percent reduction using the 400 criteria:
Number of samples without qualifiers: 39
10% samples can exceed 400 counts/100ml; therefore, highest remaining concentration is 780 counts/100ml (see Table A- 9).
Reduction to 400 is: (780-400)/780 *100 = 49%

Reduction calculated using the 400 criteria is more stringent. TMDL reduction is 49%

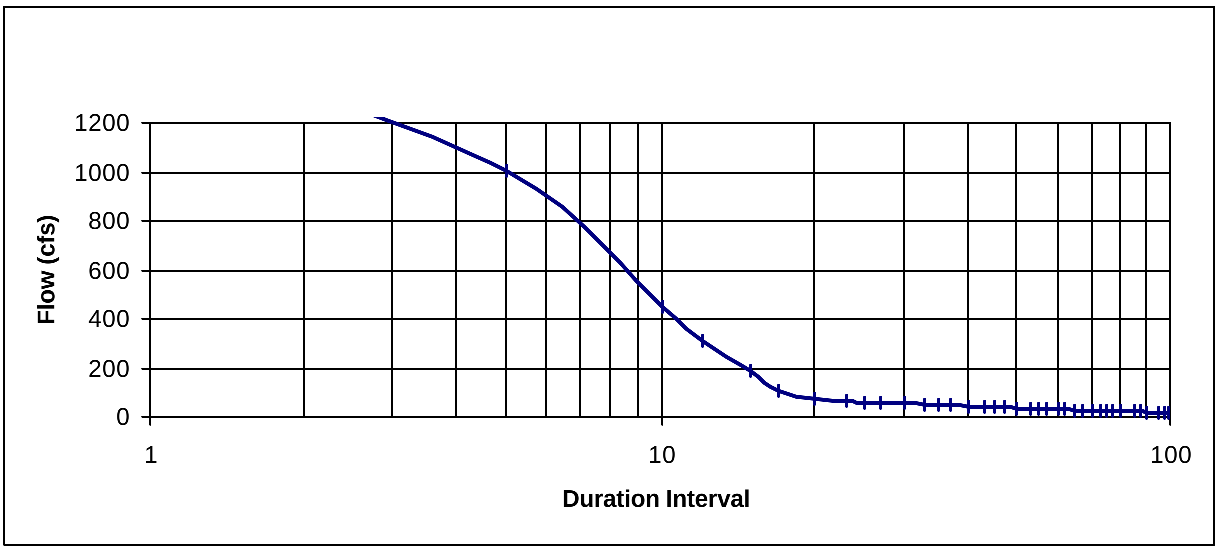

Figure B- 8. Flow Duration Curve for Ocklawaha River/Sunnyhill at Station 20020306

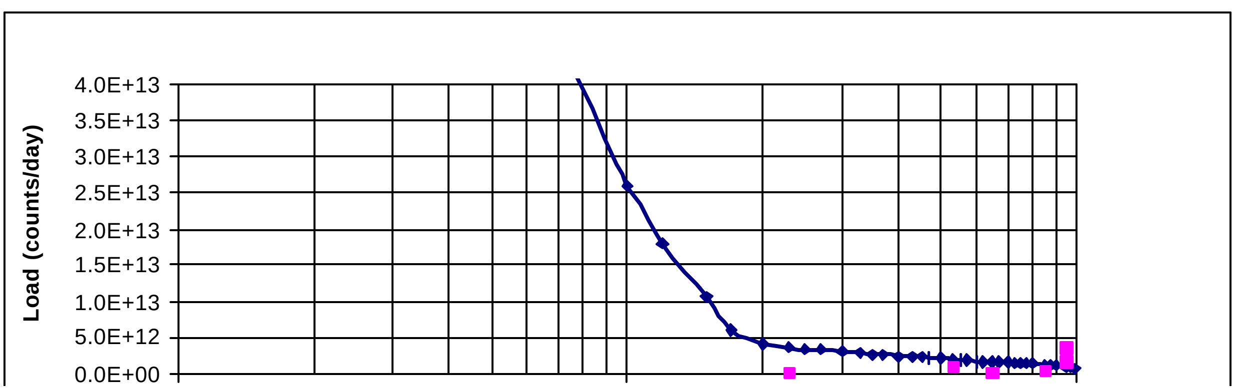

Figure B- 9. Load Duration Curve for Total Coliform in Ocklawaha River/Sunnyhill

Table B- 4. Calculation of TMDL and Percent Reduction for Total Coliform in Ocklawaha River/Sunnyhill

Largest Violation @ Station 20020306:	3.69E+ 12 counts/day
Allowable Load (based on 50th percentile of flow)	
Allowable Load (at Q_{50})	2.10E+ 12 counts/day
Percent Reduction	43.1 percent

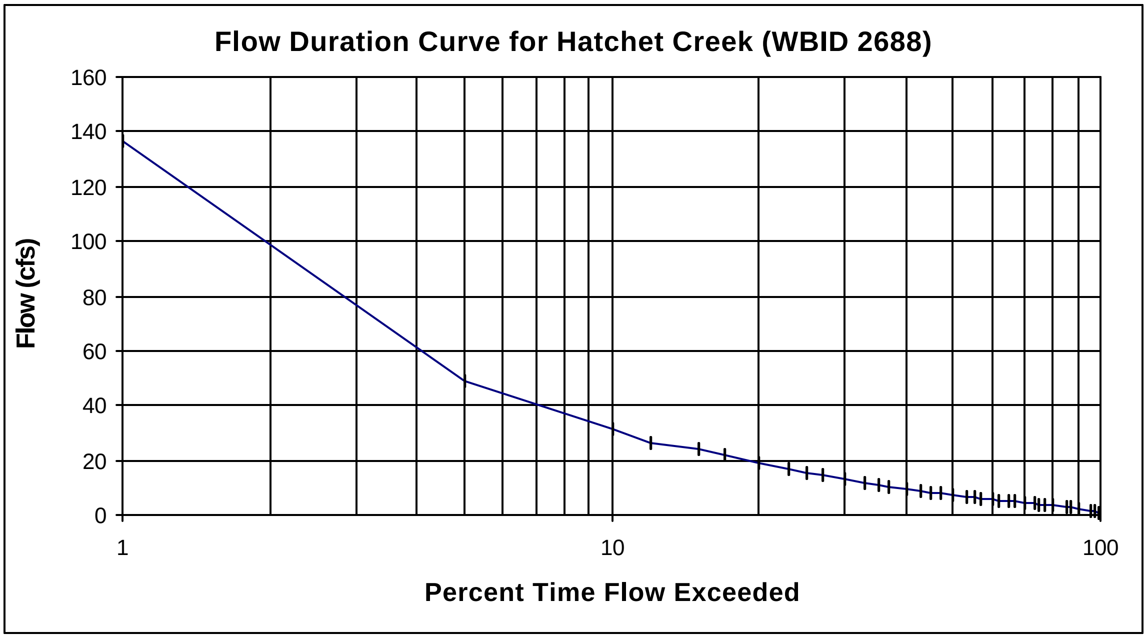

Figure B- 10. Flow Duration Curve for Hatchet Creek at Station 0224095

Table B- 5. TMDL and Percent Reduction Calculation for Fecal Coliform in Hatchet Creek

TMDL load based on the flow at the duration interval representing the 50th percentile

Flow in Hatchet Creek is estimated using a weighted drainage area of flow measured in Hogtown Creek

Flow = 7.07 cfs

TMDL Load = flow (cfs) * concentration (counts/100ml) * 28.247 L/cf *86400 sec/day * 1000ml/L

conversion factor = (28.247L/cf * 86400 sec/day * 1000 ml/L)/100ml = 24405408 sec/cf-day

TMDL = 7.07cfs * 800counts * 24405408 sec/cf-day =

TMDL = 1.38E+11 counts/day

Percent Reduction: 1 sample (without data qualifier) exceeds 800 counts/100ml

Reduction = (4800 -800) / 4800 * 100 = 83 percent

check on percent reduction to 400 criteria:

Based on number of samples collected, ignore top 3 as 10% of samples can exceed 400 counts/100ml

highest concentration remaining is : 500 counts/100ml

% reduction = (500-400)/500 * 100 = 20 percent

Table B- 6. Calculation of Fecal Coliform TMDL For Daisy Creek (WBID 2769)

Fecal Coliform TMDL Expressed as Percent Reduction Based on Data Violations

Station	Date	Concentration (counts/100ml)	% Reduction 800 criteria)	(to % Reduction (to 400 criteria)
20020146	6/23/2003	1913	58.2	79
20020026	6/23/2003	2000	60.0	80
20020025	6/23/2003	2600	69.2	85
20020118	06/23/03	800		50
		Ave. Reduction:	62.5	73

Table B- 7. Calculation of Total Coliform TMDL for Sweetwater Branch (WBID 2711)

Total Coliform TMDL Expressed as Percent Reduction Based on Data Violations

Station	Date	Concentration (counts/100ml)	% Reduction
21FLGW 7467	6/8/2000	4600	47.8
SWB SE1	3/12/2003	4900	51.0
SWB NE10	3/12/2003	17000	85.9
		average value	61.6 percent

APPENDIX C - CALCULATIONS OF METAL TMDLs

Table C- 1. Calculation of TMDL Value for Selenium in Lake Harris (WBID 2838A)

Date	Time	Rcode	Value (ug/L)	Criteria (ug/L)	% Reduction
5/30/95	1455		6.72	5.00	25.6
9/20/95	1400		9.83	5.00	49.1
7/31/95	1400		14.5	5.00	65.5
5/20/96	1140		20.6	5.00	75.7
5/20/96	1142		18.3	5.00	72.7
11/12/97	1045		72.7	5.00	93.1
3/31/98	945		37.6	5.00	86.7
5/20/98	1100		10.8	5.00	53.7
3/15/01	1015	I	7.8	5.00	35.9
			average reduction:		**62.0** percent

Table C- 2. Calculation of TMDL for AG (WBID 2740C)

Date	Result	Criteria	Reduction (%)
2/8/1995	0.1	0.07	30%
2/8/1995	0.1	0.07	30%
4/25/1995	0.22	0.07	68%
4/25/1995	0.21	0.07	67%
4/25/1995	0.34	0.07	79%
		average	**55%**

Table C- 3. Calculation of TMDL for SE (WBID 2740C)

Date	Concentration (ì g/l)	Criteria (ì g/l)	Reduction (%)	Notes
7/5/1995	14.4	5	65%	
8/21/1995	61.3	5	92%	
10/30/1995	4.9	5		
12/28/1995	7.97	5	37%	
2/21/1996	6.78	5	26%	
5/1/1996	29.8	5	83%	
5/1/1996	35.9	5	86%	
6/27/1996	1	5		
8/8/1996	1	5		
8/8/1996	1	5		
10/31/1996	1	5		
12/30/1996	1	5		
2/6/1997	2	5		
5/1/1997	4	5		
7/1/1997	1	5		
8/26/1997	1	5		
10/29/1997	1	5		
10/29/1997	7.59	5	34%	
12/15/1997	20.4	5	75%	
2/4/1998	1	5		Ave. reduction for violation 63%
4/6/1998	14.6	5	66%	
6/17/1998	1	5		
8/4/1998	1	5		
8/4/1998	1	5		
10/7/1998	1	5		
12/7/1998	1	5		
2/22/1999	1	5		
4/1/1999	1	5		
4/1/1999	1	5		
6/22/1999	1	5		
8/18/1999	1	5		
8/18/1999	1	5		
10/18/1999	1	5		
10/18/1999	1	5		

Date	Concentration (ì g/l)	Criteria (ì g/l)	Reduction (%)	Notes
12/6/1999	1	5		
2/2/2000	1	5		
2/2/2000	1	5		
4/18/2000	1	5		
4/18/2000	1	5		
6/14/2000	1	5		
6/14/2000	1	5		
8/23/2000	1	5		
8/23/2000	1	5		
10/5/2000	1	5		
10/5/2000	1	5		
12/7/2000	1	5		
2/12/2001	1	5		
4/10/2001	1	5		
6/20/2001	1	5		
8/7/2001	1	5		Value reported as 1 may have been below the detection limit
10/17/2001	1	5		

Table C- 4. Calculation of Iron TMDL for Daisy Creek (WBID 2769)

Date	Station	Result (mg/l)	Criteria (mg/l)	Reduction (%)
6/23/03	20020146	1.180	1	15
7/2/03	20020146	1.940	1	48
6/23/03	20020118	1.190	1	16
7/2/03	20020118	1.880	1	47
			Average Value	32

Table C- 5. Calculation of Silver TMDL in Lake Dora (WBID 2831B)

Date	Station	Result (ì g/l)	Criteria (ì g/l)	Reduction (%)
1/6/94	21FLSJWMDOR	0.5	0.07	86
5/26/94	21FLSJWMDOR	0.1	0.07	30
7/18/94	21FLSJWMDOR	0.3	0.07	76.7
1/5/95	21FLSJWMDOR	0.21	0.07	66.7
3/6/95	21FLSJWMDOR	0.01	0.07	
			Average Value	64.8

Appendix D - TMDL for Total Coliform in Ocklawaha River above Daisy Creek (WBID 2740D)

(Prepared by FDEP and available as a separate file on EPA's web site: http://www.epa.gov/region4/water/tmdl/Florida)

Appendix E - TMDL for Nutrients in Alachua Sink (WBID 2720)

(Prepared by FDEP and available as a separate file on EPA's web site:
http://www.epa.gov/region4/water/tmdl/Florida)

Appendix F - TMDL for Lochloosa Lake (WBID 2738) and Cross Creek (WBID 2754)

Includes TMDL for Nutrients, BOD, and DO in Cross Creek (WBID 2754) and
Nutrients in Lochloosa Lake (WBID 2738)

(Prepared by FDEP and available as a separate file on EPA's web site:
http://www.epa.gov/region4/water/tmdl/Florida)

Appendix G - TMDL for Nutrients in Lake Carlton (WBID 2837)

(Prepared by FDEP and available as a separate file on EPA's web site:
http://www.epa.gov/region4/water/tmdl/Florida)

Appendix H - TMDLs for Nutrients, DO, and BOD in Ocklawaha River

Includes TMDLs for Ocklawaha River above Daisy Creek (WBID 2740D), Ocklawaha River above Lake Ocklawaha (WBID 2740C), and Ocklawaha River/Sunnyhill (WBID 2740F)

(Prepared by FDEP and available as a separate file on EPA's web site: http://www.epa.gov/region4/water/tmdl/Florida)

EPA believes that the Ocklawaha River nutrient and dissolved oxygen TMDL will also address the listed BOD impairment for WBIDs 2740D and 2740F. Florida has no numeric water quality criteria for BOD. The water quality standard states that BOD shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions. The TMDL addresses the DO impairment by requiring a 66% reduction in total phosphorous from Lake Griffin. Since there are no point sources discharging to the Ocklawaha River, the reduction of phosphorus in Lake Griffin will reduce the production of algae in the lake, thereby reducing the production of biochemical oxygen demand from decaying algae and other plants. The reduction in algal production and in-lake plant growth should be sufficient to enable a balanced aquatic community to re-establish itself in the Ocklawaha River and maintain the appropriate BOD and DO regime for this type of waterbody.